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Coal Lease Tracts in the West - A Concise Comparision Methodology

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COAL LEASE TRACTS IN THE WEST — A CONCISE COMPARISON METHODOLOGY

Final Report

March 1979

Prepared for:

Office of Energy Activities
U.S. Environmental Protection Agency
Region VIII
Denver, Colorado 80203

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COAL LEASE TRACTS IN THE WEST — A CONCISE COMPARISON METHODOLOGY

EXECUTIVE SUMMARY

ARE ENVIRONMENTAL PROBLEMS ASSOCIATED WITH WESTERN SURFACE COAL MINING?

The answer is an emphatic yes! Many reports describe damage and changes resulting from surface coal mining in the West. Most of the studies documenting the effects of mining on the surrounding areas were conducted after the mines opened. Some, if not all, of these effects could be prevented or mitigated if problems were identified and corrective action taken before mining begins.

CAN SOMETHING BE DONE TO MINIMIZE SUCH IMPACTS IN THE FUTURE?

Before coal-bearing, federally-owned tracts are leased for mining, their environmental sensitivity should be evaluated. If environmental problems were considered early in the decision-making process of federal coal leasing, corrective measures could be developed or, if problems are severe and currently insoluble, the leasing of the most sensitive tracts could be postponed.

So, because pressure to open federal lands for coal mining is certain to continue, the U.S. Environmental Protection Agency is developing methods for analyzing and comparing tracts to determine which would be damaged least if mining were to take place.

HOW CAN THE METHOD IN THIS HANDBOOK HELP IN THIS PROCESS?

A method for comparing the environmental sensitivity of candidate lease tracts is presented in this easy-to-use handbook. The method helps users analyze information on important aspects of tracts proposed for coal leasing in three ways: First, the method organizes information and analysis about individual tracts according to six critical environmental indicators. Second, the analytical results are used to compare and rank order the tracts from least environmentally affected to most severely affected by mining. Finally, the method incorporates the values of various interest groups into the rankings so that different perspectives on the desirability of mining the various tracts can be readily perceived.

WHAT DOES THE METHOD INCLUDE?

Six impact indicators are used in this handbook: coal resource economics, hydrology and water quality, air quality, biology, socioeconomic effects, and legal/institutional constraints or conflicts.

These indicators provide a framework for relatively quantifying the probable effects of a new coal mining operation on a lease tract. Each indicator consists of several elements to enable the user of the handbook to perform more detailed analyses of proposed tracts. The method includes all effects of coal mining found to be environmentally significant in past studies.

HOW DOES THE METHOD ACHIEVE RANKINGS?

A system of relative ranking is used because determining the absolute levels of impact would be much more difficult. Points are assigned on a scale of 0 to 100 to rate the various tracts. The points for the six indicators are totaled to determine a tract's overall unweighted rating. In this handbook, the higher the rating, the more suitable a tract is for coal mining (because of less severe environmental impacts).

WHY IS COAL ECONOMICS AN IMPORTANT INDICATOR?

Determining the economic desirability of a tract is essential because a company would not lease a tract of land for mining if the return on the investment promised to be low. Clearly, therefore, knowing economic desirability of a tract early in the decision-making process is important.

WHY ARE HYDROLOGY AND WATER QUALITY AN IMPACT INDICATOR?

Coal mining and construction of associated facilities can disrupt underground water and affect surface streams and rivers as well. These disruptions often deteriorate water quality and lessen the quantity of usable water. Both impact elements are especially important when the water affected is used for domestic comsumption. Because water is a precious resource in the arid portions of the West where surface-mineable coal abounds, any development that could have long-term effects on the potable water supply there requires careful analysis.

WHAT ASPECT OF AIR QUALITY IS CONSIDERED?

"Fugitive" dust is the major air pollution problem associated with coal mining. The amount of emissions depends mainly on three elements: the quantity of overburden moved and stored, the amount of traffic on unpaved haul roads, and the susceptibility of the area to wind erosion. Based on these factors, fugitive dust creation can be estimated before a tract is leased.

WHAT IS THE IMPORTANCE OF THE BIOLOGICAL INDICATOR?

Coal mining often permanently alters the distribution of the animal and, especially, the plant communities near the site. The biological indicator appraises the reclamation potential of the proposed tracts and assesses the relative uniqueness of each habitat (for example, whether endangered species breed there). Combined, these elements provide a good basis for comparing proposed lease tracts.

WHY ARE SOCIOECONOMIC FACTORS INCLUDED?

Many tracts proposed for federal coal leasing are in sparsely populated areas. Communities in these rural areas tend to be small and oriented towards agriculture. Such small farm communities generally lack a sufficient infrastructure to handle the rapid population growth that accompanies coal mines, and as a result, new mines often cause the well-documented "boomtown" phenomena. Many of the negative effects of such unusually rapid development can be avoided through planning and implementing specific corrective measures. The socio-economic impact elements identify potential problems early and thereby allows time to formulate mitigating measures.

WHAT ARE THE LEGAL/INSTITUTIONAL CONSTRAINTS?

The legal/institutional constraints on coal development are many. Those resulting from particular laws and regulations are reflected in the air, hydrology and water quality, and biology indicators. Consequently, the legal/-institutional indicator deals primarily with legal restrictions on the use of land. In particular, it appraises alternative land uses and possible conflicts between the owners of surface and mineral rights. Split ownership of these rights can create serious legal problems, but possible ownership conflicts can often be negotiated.

HOW ARE TRACTS COMPARED AND RATED TO DETERMINE RELATIVE SUITABILITY?

After points are assigned to each element comprising an indicator, the points are added to obtain a total score for each indicator. This score permits a comparison among tracts along each indicator without yet bringing in the value orientations of interest groups. Next, to include values orientations, each indicator score is multiplied by a weighting factor and the sum of these weighted indicators gives a weighted overall rating for the tracts. This process can be repeated for a series of value-orientations held by interested parties. Once tracts are ranked according to their overall ratings for each interested party, users can see how different value orientations could affect the rankings. This provides insights into the way potential stakeholders would view proposals to lease the various areas, and therefore can help prepare interested parties for the controversies that may arise when tracts are offered for lease.

WHAT INTEREST GROUP VALUE ORIENTATIONS ARE INCLUDED IN THE HANDBOOK?

Five interest groups representative of the people who would have a major interest in the leasing of coal tracts are treated in this handbook: environmental activists, coal mining companies, local governments, local citizens, and cognizant federal agencies (which might adopt a weighting similar to those of the SRI study team). Each group would weight the impact indicators differently to specify the relative importance that group attaches to each indicator. All of the weightings employed in the handbook are considered to be reasonable reflections of the values held by members of the groups represented.

HAS THE METHOD EVER BEEN TESTED?

The method was tested on 12 coal lease tracts located in Yampa and Danforth Hills, 2 Known Recoverable Coal Resource Areas (KRCRA) in northwestern Colorado. This area was chosen by the Environmental Protection Agency as the testing ground for the methodology. The SRI study team gathered data on the test case areas through a combination of fieldwork, examination of published souces, and personal communication with experts in the various areas.

WHAT WERE THE RESULTS OF THE TEST?

Once the indicators had been evaluated for all the tracts, final rankings were obtained using the comparative value perspective technique. Several interesting things were revealed: First, the different value perspectives of the various groups often led to similar overall rankings, but for disparate reasons. Second, complete agreement was never achieved on the desirability of a tract, although two groups sometimes agree on the ranking order of a particular tract.

CAN THIS METHOD BE APPLIED TO ANY TRACT PROPOSED FOR LEASING?

The method was specifically designed to evaluate surface-mineable coal lease tracts in the West. However, the concept is flexible and could be applied to almost any area after suitable modification of the indicators.

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I INTRODUCTION

A. Purpose

This handbook sets forth six "impact indicators," for the purpose of representing and comparing the effects that might be expected from mining coal from particular tracts of land. These indicators are Biology, Air Quality, Water Quality/Hydrology, Socioeconomic Effects, Legal/Institutional Constraints, and Coal Resource Economics.

Because the indicators are not the results of quantitative models, they can only be semi-quantitative. Also, for the purposes of comparing lease tracts, they constitute measures that must be considered relative, rather than absolute. An important underlying assumption is that in the tracts being compared the coal is essentially identical in quality and, therefore, interchangeable as far as the ultimate users are concerned.

B. Method

The method of estimating the impact indicators varies slightly from one impact category to the next. Each topic, or indicator area, requires the judgment of someone knowledgeable in the subject. Some methods are more precise than others. The differences, however, are understandable because some indicators are composed of elements which are estimated in a concise, quantitative fashion, whereas others are subject to many judgmental factors. With socioeconomic issues, for example, most questions are not clear-cut, and the formulation and evaluation of impact indicators depends primarily upon the judgment of an experienced analyst. Hydrological issues, on the other hand, are much easier to quantify.

Many of the impacts evaluated in deriving the indicator scores do not occur at the same time and do not show the same persistence. Some happen early and others occur later; some cease when the mining ceases and others persist for decades after the mining ends. However, rather than complicate this methodology by introducing a time component in the indicators, we have used our professional judgment to combine effects and to allocate the relative stress the various impact elements that occur at different times should receive. In the socioeconomic indicator, for example, we emphasize the disruptive effects that occur early even though the initial difficulties diminish as communities adjust as time passes.

The user of this handbook should keep in mind that the purpose of the handbook is to provide a technique to judge the relative desirability of developing various coal lease tracts. The comprehensive prediction of absolute levels of impacts is beyond the scope of this work.

Because the indicators themselves are not physical quantities, they must be expressed on an arbitrary scale. The scale chosen for all the indicators is 0 to 100. The convention chosen for consistency is that high indicator values correspond to a greater desirability of leasing the tract and low values represent a lesser desirability.

Factors have been developed to help the user derive indicator scores in each major impact category. The indicators are then added to obtain an overall score for each lease tract. This is illustrated in Figure I-1. A final weighting system, "comparative value perspectives," is applied to the overall scores. The technique shows how conclusions might vary depending on the values held by the person doing the analysis. The scores are then used to rank the tracts. The tract that has the highest score is the one that would be the most desirable to mine, whereas the tract with the lowest score would be considered the least desirable.

An examination of the methodology shows that considerable judgment has been used in assigning values to the various elements that contribute to the indicators, and in the procedure for combining those elements to obtain the scores of the indicators. Such judgments are based upon the experience of the project team that developed this handbook, as well as on an examination of the relevant literature. Although we intend that users of the methodology follow the estimation procedures set forth in the handbook, there is enough flexibility to allow users to substitute their own judgments in the procedure whenever they feel it is appropriate.

Although the methodology is intended for coal lease tracts in the West, the approach is flexible and could be extended to other parts of the United States after suitable modifications are made to the indicators.

C. Worksheets

Worksheets are included in the handbook to facilitate its use. The user can simply read through the handbook to gain an understanding of the indicator areas, and then use the worksheets to systematize his work. Each of the indicators has many inputs that are combined in a final ranking of each tract for that particular problem area. A weighting -- like a handicap in a horse race -- is applied to some of the elements within the indicators so that each indicator will receive equal stress.

D. Test Case

Northwest Colorado was the area chosen for testing the methodology. Twelve tracts in that area were selected, all of them in either the Danforth Hills or Yampa Known Recoverable Coal Resource Areas (KRCRA). The analysis of the test case is presented in Appendix A.

E. Other Information

A detailed look at pertinent federal legislation and an overview of state and local regulatory measures make up Appendix B. A bibliography of the information sources used in developing and testing the methodology is also included, to help users locate data required when they apply the methodology.

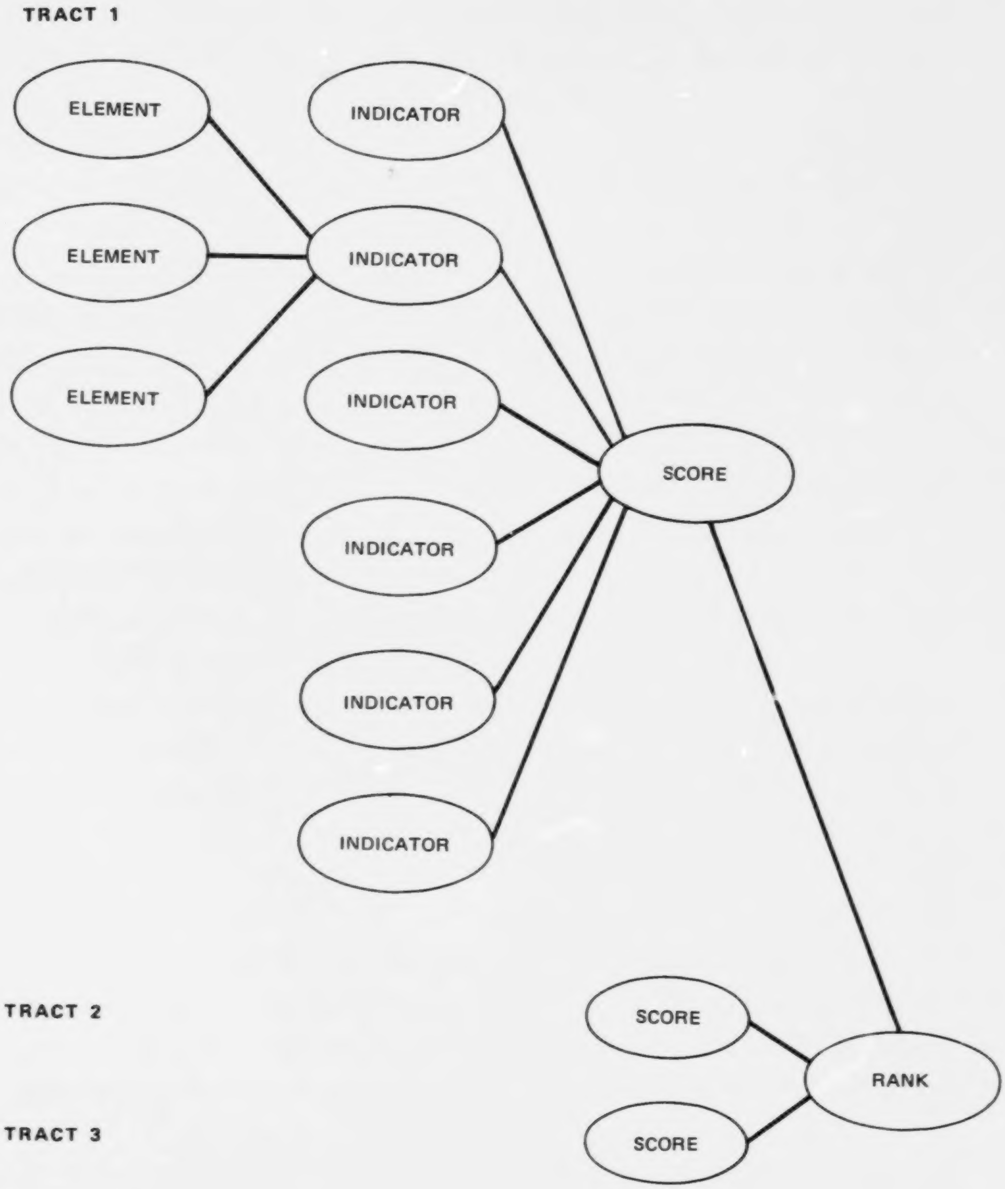

TRACT 1
ELEMENT
INDICATOR
ELEMENT
INDICATOR
ELEMENT
INDICATOR
SCORE
INDICATOR
INDICATOR
INDICATOR
TRACT 2
SCORE
RANK
TRACT 3
SCORE

FIGURE I-1. SCORING OF EACH TRACT RESULTING IN RANKING OF THE RELATIVE DESIRABILITY OF THE MINING

II COAL RESOURCE ECONOMICS

A. Introduction

Determining the economic attractiveness or desirability of a tract is an essential factor in the decision process. A company would probably not lease a tract of land for mining if it had prior knowledge that the return on the investment would be low. It is therefore important to determine whether a particular tract is economically desirable.

Three critical factors will be used as elements of the economic desirability of a proposed lease tract: the amount of coal in the tract, the minimum selling price of the coal, and the heating value of the coal. These elements can be applied to any lease tract to determine whether a company would choose to open a mine there.

B. Necessary Information

Before judgments of the economic desirability of a lease tract can be made, specific information on each of the three elements must be collected. Relative rankings of tracts must be based on adequate data for each one.

1. Amount of Coal in the Tract

This is the estimated quantity of coal in the tract that is economically minable with present technology and at current prices. We assume that tracts with larger amounts of strippable coal will be more economically desirable. However, quantity is not the only factor to be considered.

2. Minimum Selling Price of the Coal

This is the minimum price that a coal company must charge for the coal to obtain a normal rate of return on its investment. Tracts that contain coal in thin seams or at great depth will have a higher minimum price than those with coal in thick seams or at shallow depths. The minimum selling price is inversely related to some of the impacts; that is, a high minimum price reduces the income for the stockholders because there will be less difference between the minimum selling price and the actual price, allowing less additional profit above the minimum price. This additional profit is sometimes called "economic rent." An example of a direct relationship between minimum price and adverse economic impact is that a higher minimum price will exert upward pressure on the market price, resulting in further inflation. In other cases, minimum price scales directly with beneficial impacts. For example, higher production costs associated with a higher minimum price provide greater employment. If those additional jobs are filled by unemployed workers, more taxes are generated, providing greater tax-supported benefits and reducing unemployment insurance and welfare payments. In addition, greater production is required from industries supplying goods and services to the mine.

3. Heating Value of the Coal

The heating value (conventionally expressed in units of Btu per ton) is a direct measure of the usefulness of the coal as fuel per unit cost of extraction. Extraction costs generally are proportional to the quantity of coal, extracted irrespective of its heating value. To a first approximation, the costs and economic resources required to operate the mine are independent of the heating value of the coal being mined.

Other measurable variables considered, such as the amount of land surface required, the volume of overburden that must be removed, or the number of employees required, scale in approximtely the same manner as the quantity of coal. These are more applicable to air quality and socioeconomic impacts, and are considered in those sections of the handbook.

Although none of the three variables described is an absolute measure of the economic desirability of the site, the following combination does yield a useful indicator in the following form:

Indicator = Q/P^a , where

Q = total energy content of the economically minable coal in the tract (i.e., the product of tonnage to be mined and the heating value per ton)

P = minimum selling price of the coal per million Btu

a = constant number less than 1.

Another, more directly useful expression of the indicator is given on page II-8.

The rationale behind this combination of elements is as follows: It is logical to assume that the overall economic benefit of opening new coal mines on a tract is beneficial, or else no mining company would be interested, and the government would not be considering a lease program. The dominant reason for leasing is to make available to society additional energy resources. Hence, the quantity of energy in a tract is useful as a primary element in determining an indicator. Minimum selling price is a second element because it inversely represents the economic attractiveness of the tract to mining companies. That is, the lower the minimum price that must be charged to make an adequate profit, the greater the potential additional profit to a company. Because the government has lease programs to encourage private development of coal in the public interest, those tracts that have lower costs of extraction (lower minimum prices) should generally be preferred for lease. Use of the exponent, a, is merely a mechanism to reduce the influence of the minimum selling price element relative to the quantity of coal. The suggested magnitude of the exponent is ½; this is a purely subjective estimate.

Data on the coal resources in each tract put up for lease will be avilable from a coal inventory program being conducted by the USGS as mandated by the Federal Coal Leasing Amendment Act of 1976. For this program, the USGS will prepare and publish Coal Resource Occurrence (CRO) and Coal Development Potential (CDP) maps before preliminary identification of proposed lease tracts. These maps will identify not only the quantity of coal in each tract, but also seam and overburden thickness. To date (February 1979), no CROs or CDPs are available for public use, although several are in preparation. These maps and their acompanying information are anticipated to be more definitive than any other available sources, and should therefore be the primary data source for information on quantity of coal in each tract, seam thickness, seam depth, and energy content (Jobin, Daniel).

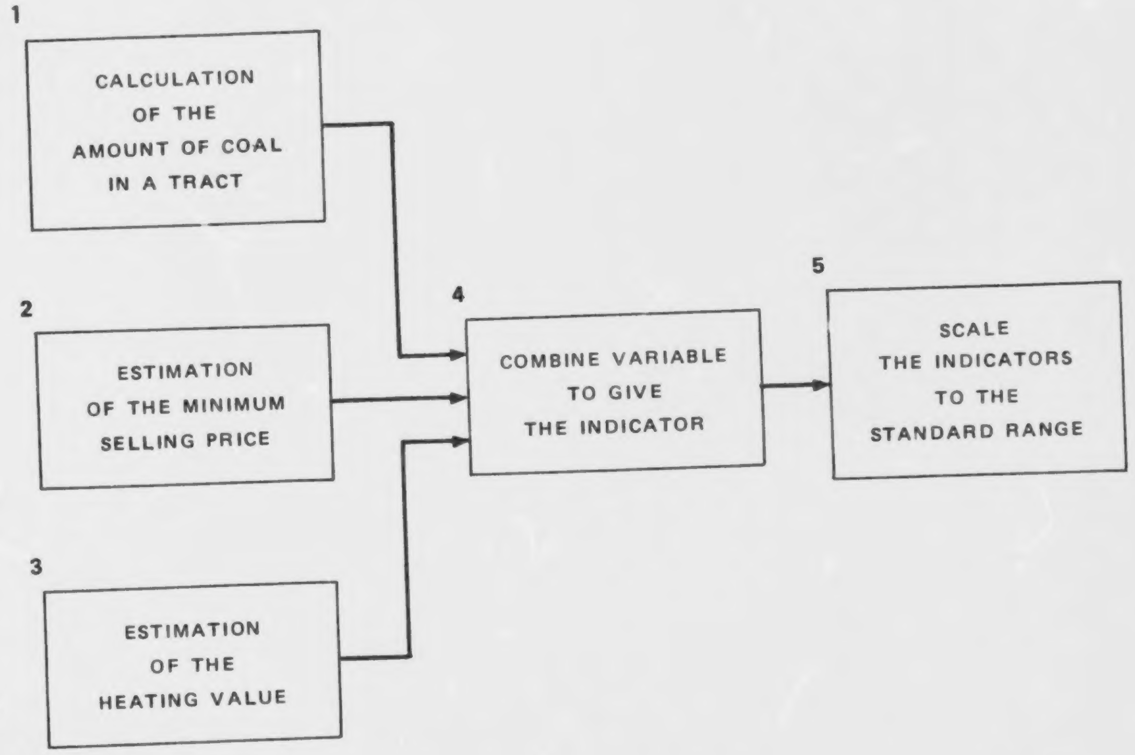
C. Methodology for Estimating the Coal Resources

1. Calculation of Amount of Coal in a Tract (Step 1)

Figure II-1 illustrates the entire process for deriving the coal resource economics impact indicator. Estimation of the amount of coal in a tract (step 1) should be based on the data to be provided by the USGS CDP and CRO maps.

2. Estimation of the Minimum Selling Price (Step 2)

To estimate the minimum selling price, the cost of extracting the coal must be estimated. That requires assumptions concerning the type of surface mining equipment to be used, the size of the mining operation, the average depth of overburden to be removed, and the average thickness of the seam. For the purposes of this methodology, a mine producing 1 million tons of clean coal per year will be used as a basic building block. That is, the estimated amount of coal in the tract will be assumed to be mined by separate mining operations that will each extract 1 million tons per year (mtpy). In many tracts with 100 million tons of coal or more, it is more economical to use larger mining operations of 5 to 10 or more mtpy to realize economies of scale. However, the economies of scale realized by developing large surface mines rather than several small surface mines have been shown by



1
CALCULATION OF THE AMOUNT OF COAL IN A TRACT
2
ESTIMATION OF THE MINIMUM SELLING PRICE
3
ESTIMATION OF THE HEATING VALUE
4
COMBINE VARIABLE TO GIVE THE INDICATOR
5
SCALE THE INDICATORS TO THE STANDARD RANGE

FIGURE II-1. STEPS TO THE COAL ECONOMIC IMPACT INDICATOR

a detailed simulaton model analysis of both the operations and financial performance of surface mines done by Fluor, Inc. (Fluor Utah, Inc.) to be quite small for mines producing more than a half million tons per year. The justification for the 1 mtpy building block is that the small mine size allows price estimates for tracts that have relatively small amounts of coal, as well as those with very large amounts.

The minimum selling price estimate can be based on the use of either shovels and trucks or draglines for overburden removal. Generally, draglines are used in the West unless the coal seam is very thick (greater than about 20 ft) or very deep (greater than 100 ft), in which case shovels and trucks are more commonly used.

We have assumed that the minimum economical lifetime for a mine is at least 15 years. Thus, if a proposed tract is estimated by public sources to have less coal than will support a 1-mtpy mine for 15 years, one must assume that the mining company that proposed the tract for leasing possesses measurement data that indicate at least 17 million tons of coal (15 million tons of clean coal divided by a 0.9 recovery factor).

The two most critical characteristics of coal that determine the cost to surface-mine it are the overburden depth and seam thickness. These characteristics are often combined into a measure called the "strip ratio," but they must be dealt with separately in sizing a mining operation. Estimates of these quantities should be obtained from the USGS map information described previously.

Given the foregoing assumptions, in addition to a required discounted cash flow rate of return on the investment of 15%, a typical minimum price for a range of seam thickness values is shown in Figure II-2. This curve was derived by using a detailed coal mining production cost model developed by SRI from work done by NUS Corporation.* By entering the figure with an estimated average seam thickness for the tract derived from the USGS data, as previously described, an estimated minimum price can be obtained.

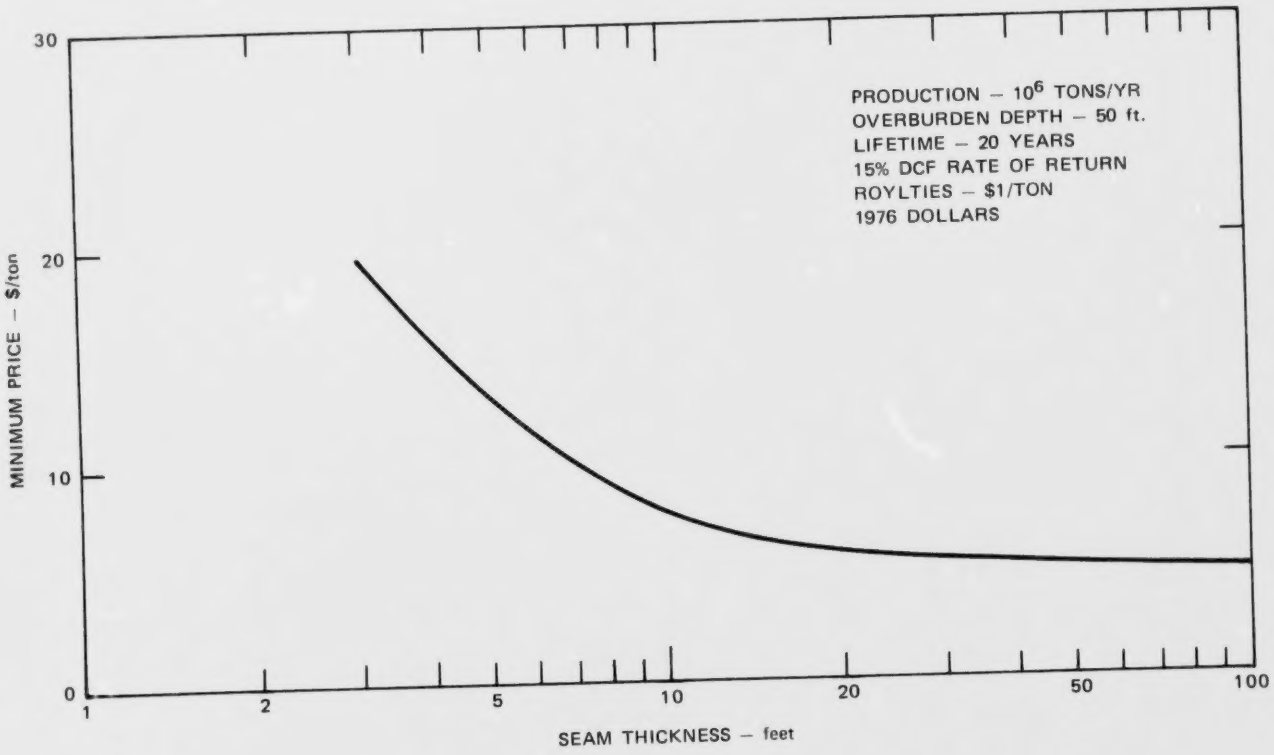


FIGURE II-2. ESTIMATED MINIMUM PRICE

3. Estimation of the Heating Value (Step 3)

The heating value, in units of 10^6 Btu/ton, should be obtained from the chemical analyses of the coal in proposed tracts prepared by the USGS under the coal inventory program described previously.

4. Combining the Variables to Give the Indicator (Step 4)

Once derived, the variables can be combined into the proposed indicator, as follows[**]:

Indicator = $(T \times B^{3/2})/R^{\frac{1}{2}}$, where

T = amount of coal in million tons

R = minimum price in dollars/ton

B = heating value in million Btu/ton.

5. Scaling the Indicators to the Standard Range (Step 5)

To scale the set of raw indicators for the tracts being compared to the range of 0 to 100, the highest raw indicator score can be set to 100. The scaling factor used to adjust the other raw indicator values is derived by dividing 100 by the highest raw indicator score, all other raw indicators are then multiplied by this scaling factor, to yield the adjusted indicator score.[***]

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[*] NUS Corporation, "Coal Mining Cost Models -- Surface Mines," for Electric Power Research Institute, EPRI GA-437 (1977).

[**] The formula is equivalent to that shown earlier in this section. The variables T and R are the same as Q and P but are expressed in units of tons rather than Btu. B is used to make the conversion. Thus, $(T \times B^{3/2})/R^{\frac{1}{2}} = Q/P^{\frac{1}{2}}$.

[***] If the highest raw indicator value were 57, then the scaling factor would be 100/57 = 1.75.

COAL ECONOMICS WORKSHEET

Tract	Quantity (10^6 tons)	Minimum Price ($/ton)	Heating Value (10^3 Btu/lb)	Unscaled Raw Indicator	Scaled Indicator	Ranking
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

III HYDROLOGY AND WATER QUALITY IMPACT INDICATOR

A. Introduction

This indicator incorporates two elements: hydrology and water quality. Because each element consists of characteristics which do not influence the elements in the same way, different weights must be assigned. The most important characteristics were given the highest weight on a scale of 0.01 to 1.0. The characteristics were assigned weights based on how they compared to the first. The weights must sum to 1.0. For instance, topography is assigned the weight 0.25. That means that 25% of the value for the total indicator should be derived from this characteristic. Likewise, potable supply is assigned a value of 0.10, meaning that only 10% of the value for the hydrology element should be derived from that characteristic. The weighted values for each tract are then summed separately for the hydrology and water quality elements. To determine the ranking of the lease tracts for the Hydrology and Water Quality indicator, the values for the hydrology and water quality elements are averaged for each tract. The result is one score representing a composite of the two elements. The entire process is illustrated in Figure III-1. Worksheets are located at the end of the chapter.

B. Data Sources

The U.S. Geological Survey has computer storage and information retrieval of most surface and ground water data collected by it. State geological surveys or state water engineering offices have information on water availability, water quality, and water use. The U.S. Environmental Protection Agency has a computer system that shows location and amount of discharges. State natural resource or environmental protection offices have similar data, as well as water quality data from public drinking water supplies. State agricultural agencies have some information on quantity and quality of irrigation waters. The Soil Conservation Service has soil maps for many areas or can provide general information on soil erodability and composition. Information on regional geology can be obtained from USGS maps or district geologists, and from state geological survey maps and personnel.

C. Hydrology Element Methodology

This methodology was designed to be used by individuals who have experience in hydrology. Five characteristics, categorized by data type, make up the hydrology element: percent recharge, alluvial aquifers, drainage density, topography, and potable supply. Table III-1 summarizes the characteristics and provides guidance for assigning values to each.

1. Groundwater -- Percent Recharge (Step 1)

The amount of recharge area for groundwater aquifers or alluvial systems in the coal lease area is an important measure of potential hydrologic impact. Mining coal or constructing associated facilities in a recharge area can have a disrupting effect on the overall groundwater hydrology of the region. The magnitude of the effect, however, depends primarily on the following characteristics of the aquifer: geographic extent, porosity, hydraulic conductivity, and storage capacity. A change in water quality often accompanies a change in groundwater hydrology.

As shown in Table III-1, the percentage of the coal lease area considered to be recharge is correlated with a nominal scale according to the relative effect expected. If less than 5% of the area is recharge, there will probably be minimal effect on the groundwater hydrology of the region. Therefore, this case is assigned a value of 100.

To estimate the amount of recharge, the boundaries of each lease tract must first be drawn on a USGS 7½ minute topographic map. The recharge areas are then roughly outlined on each tract, the percentage of the tract designated as recharge is estimated, and the information is recorded on the worksheet located at the end of this chapter.

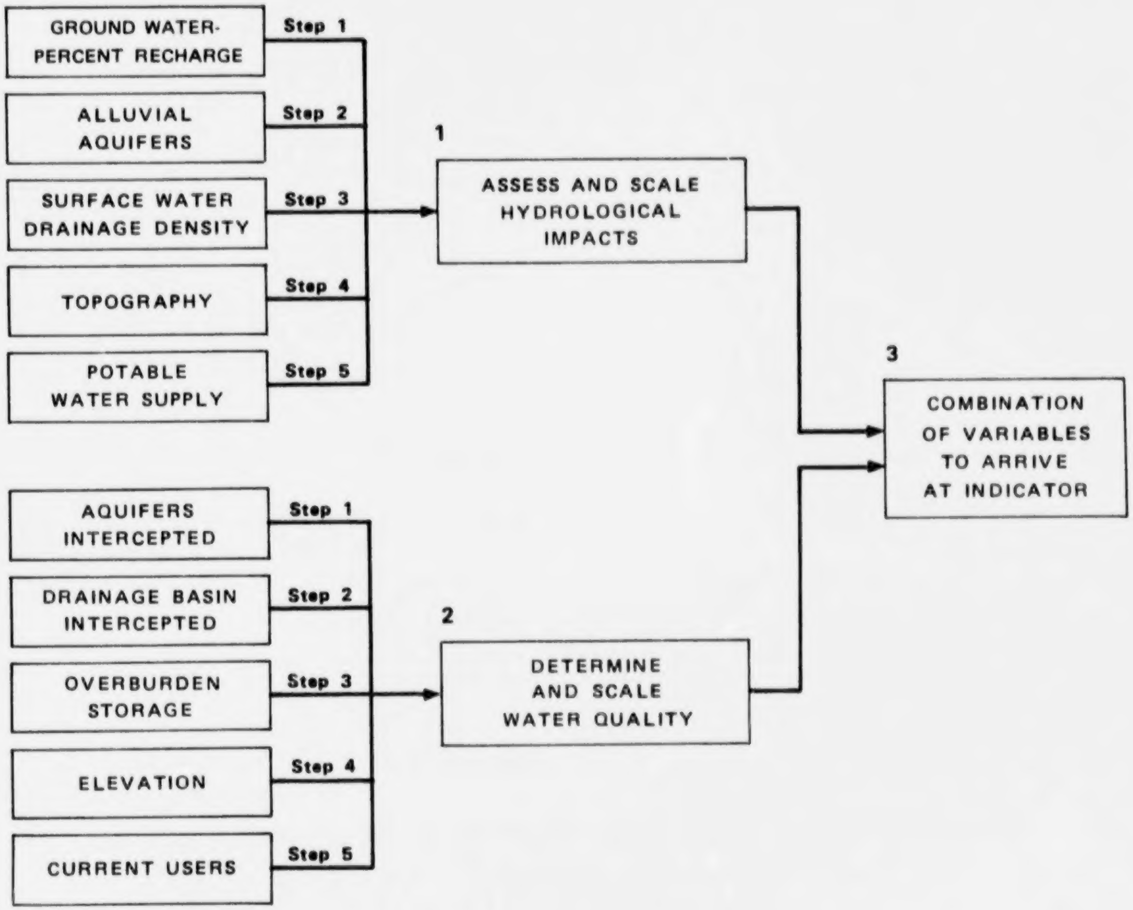
GROUND WATER-
PERCENT RECHARGE
ALLUVIAL AQUIFERS
SURFACE WATER DRAINAGE DENSITY
TOPOGRAPHY
POTABLE WATER SUPPLY
Step 1
Step 2
Step 3
Step 4
Step 5
1
ASSESS AND SCALE HYDROLOGICAL IMPACTS
AQUIFERS INTERCEPTED
DRAINAGE BASIN INTERCEPTED
OVERBURDEN STORAGE
ELEVATION
CURRENT USERS
Step 1
Step 2
Step 3
Step 4
Step 5
2
DETERMINE AND SCALE WATER QUALITY
3
COMBINATION OF VARIABLES TO ARRIVE AT INDICATOR

FIGURE III-1. APPRAISAL STEPS FOR THE HYDROLOGY WATER QUALITY IMPACT INDICATOR

TABLE III-1

CHARACTERISTICS CONSTITUTING THE HYDROLOGY ELEMENT AND POTENTIAL VALUES AND WEIGHTS TO BE ASSIGNED

Characteristics	Value[a]			Assigned Weight
	Minimal Effect 100 Points	Moderate Effect 50 Points	Major Effect 10 Points[b]	
Percent Recharge	Less than 5%	40%	More than 75%	0.25
Alluvial Aquifers	No known discharge areas; no perennial streams; few intermittent streams.	No more than short stretches of perennial stream crossing tract; less than 5 intermittent streams; one or more known discharge areas.	At least one perennial stream; 5 or more intermittent streams; several known discharge area.	0.20
Drainage Density	Less than 1.0	At least 2.5	More than 5.0	0.20
Topography	Gentle upland slopes (less than 5%); extensive alluvial plains.	Moderate upland slopes (less than 20%); moderate fan or floodplain development.	Steep upland slopes (in excess of 30%) high relief, little or no floodplain development.	0.25
Potable Supply	Total dissolved solids are greater than 1,000 mg/l; yield less than	Total dissolved solids are less than 500 mg/l; yield is at least 500 gpm.	Total dissolved solids are less than 100 mg/l; yield greater than 1,000 gpm.	0.10

---

[a] Interpolation between the three levels can be made based on the experience of the user.

[b] If a very severe effect is expected, the assigned value may be lower than 10.

2. Alluvial Aquifers (Step 2)

Alluvial aquifers can be important local sources of water for both humans and wildlife. Mining activities have the potential for significant disruption of alluvial aquifers because of their sensitivity to land use changes. Table III-1 provides a guide for differentiation among lease tracts. Basically, if few springs or streams are present, effects will be minimal. The determination of alluvial aquifers and discharge areas is based on an evaluation of USGS 7½-minute topographic maps and hydrologic summaries of the region (if available).

3. Surface Water Drainage Density (Step 3)

The major characteristic chosen for analysis is drainage density (DD), defined simply as the stream length per unit area:

$$DD = \frac{\Sigma L}{A}$$

where ΣL is the cumulative length of all streams on the tract and A is the tract area. Traditionally, this concept has been applied solely to drainage basins as an indication of the size of the drainage network in each basin and as a basis for comparison among several basins (Leopold, Wolman, and Miller, 1964). It is used here to define the size of the drainage network in each lease tract as a measure of hydrologic effects of mining. According to our analysis, with a larger drainage network per unit of area, a larger effort is required to control runoff, erosion, and groundwater contamination. Therefore, a tract with large drainage density would receive a low value using our methodology (see Table III-1).

Because lease tracts will usually be less than 15 square miles, drainage density values will be quite low. To determine cumulative stream length (L), the length of all perennial, intermittent, and ephemeral streams (arroyos) is calculated from USGS 7½-minute topographic maps using a map measure (opisometer). Rills and gullies need not be included. If the area of the tract is not available, it is calculated with a planemeter.

4. Topography (Step 4)

Topography has a significant effect on volume, intensity, peak, and duration of runoff. Each of these in turn affects the surface water control measures required for a particular lease tract. The values shown in Table III-1 were developed in a study by the Pacific Southwest-Interagency Committee (PSIAC) (1968). Generally, steep slopes result in rapid runoff. The influence of topography depends to a large degree on geology, soils, ground cover, orientation, and size. However, examination of topography alone should provide a reasonable differentiation between tracts within a given region. General slope percentages for each tract are estimated from USGS 7½-minute topographic maps.

5. Potable Water Supply (Step 5)

If a perennial stream crossing the lease tract or an aquifer under the lease tract contains potable water (meeting U.S. Public Health Service and EPA Safe Drinking Water standards), the value of that water is very high in the water-short western states. Therefore, using that water for nondomestic uses or degrading its quality represents an opportunity cost of development. As shown in Table III-1, the value assigned depends on both water quality and quantity. The values presented are a guide, and the user may decide to change them slightly, on the basis of local water supply conditions. The figure for total dissolved solids (TDS) has been selected as a simple measure of water quality because of the availability of data and because excess salts present a common problem in the West. Yield is taken to mean a measure of quantity, and is defined in Table III-1 as safe yield for aquifers and a withdrawal equalling less than 50% of the mean low flow for surface water streams. A lower value is assigned for water supplies with good water quality and high yield. Interpolation between the values must be based on the user's best judgment.

D. Water Quality Element

This methodology was designed to be used by individuals who have experience in hydrogeology. Five characteristics have been selected to constitute the water quality element: aquifers intercepted, drainage basin intercepted, overburden storage, elevation, and current uses. Table III-2 provides a summary of the characteristics and the assigned values and weights for each.

1. Aquifers Intercepted (Step 1)

The number of aquifers intercepted by mining operations and the quality of the ground water contained in the aquifers will significantly influence the control and treatment measures required to meet existing federal and state regulations. According to the Surface Mining Reclamation and Enforcement Act (Federal Register, 13 December 1977, pp 62639 - 62716), the mine operator is required to treat all water discharged from the site if it does not meet established water quality standards. Therefore, if mine dewatering results in large volumes of poor quality water, the operator must take provisions to store, control, and treat the water, which imposes significant additional costs. Furthermore, the likelihood of accidental discharge of contaminated water is increased. With our methodology, the more aquifers intercepted and the poorer the water quality of the aquifers, the lower the assigned value (see Table III-2). The number of aquifers provides a simple measure, rather than a detailed analysis, of the volume of discharge (yield). TDS are taken as a reasonable representation of overall water quality. Number and quality must be combined to assign a value. Minimal effects are assumed if, for example, the water quality is fairly good and the number of aquifers intercepted is low. However, some judgment by the user is necessary to interpolate between the values indicated. For example, poor water quality (on the order of 1,000 mg/l) and a small number of aquifers intercepted (probably less than 3) should have an assigned value somewhere between 40 and 80.

2. Drainage Basin Intercepted (Step 2)

Proximity of a lease tract to a major drainage basin is an important indication of potential water quality problems. Any breaches in holding ponds or reservoirs or upsets in the wastewater treatment process can cause release of contaminants. If a large stream is

TABLE III-2

CHARACTERISTICS CONSTITUTING THE WATER QUALITY ELEMENT AND POTENTIAL VALUES AND WEIGHTS TO BE ASSIGNED

Characteristics	Value[a]			Assigned Weight
	Minimal Effect 100 Points	Moderate Effect 50 Points	Major Effect 10 Points[b]	
Aquifers Intercepted	No more than 1 aquifer intercepted; total dissolved solids less than 300 mg/l.	At least 3 aquifers intercepted; total dissolved solids less than 500 mg/l.	More than 5 aquifers intercepted; total dissolved solids more than 1,000 mg/l.	0.25
Drainage Basin Intercepted	Less than 50 square miles.	At least 500 square miles.	More than 1,000 square miles.	0.20
Overburden Storage	Small in comparison to storage sites.	Moderate in comparison to storage sites.	Large in comparison to storage sites.	0.10
Elevation	Generally greater than 8,000 feet.	Generally 7,000 feet.	Generally less than 6,000 feet.	0.20
Current Uses	More than 20 miles to nearest public or domestic use.	At least 20 miles to nearest public or domestic use	Less than 0.5 miles to nearst public or domestic use.	0.25

---

[a] Interpolation between the three levels can be made based on the experience of the user.

[b] If a very severe effect is expected, the assigned value may be lower than 10.

relatively close, contamination can move rapidly and at great distance through the drainage basin before the release can be controlled. The potential for affecting human water supplies is substantial.

Recognizing the importance of selecting a characteristic to represent this potential water quality problem, we spent considerable effort analyzing possible approaches. Several approaches were investigated that would use Horton's stream ordering technique (Horton, 1945) as an analog for drainage basin size, or in other words, as a determination for what should constitute a "major" drainage basin. Although a variation of this technique might provide the necessary differentiation, the mechanics of applying this technique are too time-consuming.

The approach finally selected is simpler, yet provides the necessary information. A USGS 7½-minute map is examined for each site. The largest stream on each lease tract is selected and the drainage area is estimated. If no perennial stream crosses the tract, a second step is required. The user should select the largest intermittent stream and proceed downstream until a perennial stream is encountered or until 10 stream miles are counted off. The drainage area of the perennial stream is then estimated. The larger number is used in estimating the value as shown in Table III-2.

3. Overburden Storage (Step 3)

The regulations of the Surface Mining Reclamation and Enforcement Act provide for handling and control of overburden. Depending on the type of reclamation, some volume of overburden is stored on site under carefully controlled conditions for some period of years. Thus, the smaller the volume, the easier it is to control. In addition, lease tracts with no arroyos or valleys in which to store the overburden have more severe requirements. Consequently, the characteristic selected takes both volume and storage locations into account. We assume a worst case condition in which all overburden must be stored for the life of the mine. In normal practice, storage is required only for the overburden from the initial cut. An average overburden depth of 50 ft is used for this methodology. The "overburden storage" column is calculated by multiplying the overburden thickness by the surface area mined. The surface area mined is obtained by multiplying the tonnage mined by the volume of a ton of coal and then dividing by the thickness of the coal seam. Potential storage sites for each lease tract should be identified on USGS 7½-minute topographic maps. Care should be taken to select sites that are away from perennial streams, springs, and ponds or reservoirs. The volume for each site selected should be calculated by multiplying the average depth of the valley by its surface area. This volume is then compared with the total volume of overburden that must be stored. Because the scale is relative, as shown in Table III-2, the users are required to employ their best judgment in ranking the lease tracts in a region.

4. Elevation (Step 4)

Precipitation and other climatic factors affect the development of vegetation and soil, erosional characteristics, evaporation rate, snow accumulation, and overall basin water quality. Generally, the amount of precipitation increases with increasing elevation. Therefore, elevation has been selected as a water quality measure. At higher elevations but below the timberline, vegetation is more dense and reduces the volume and rate of runoff, thereby decreasing sediment yield. At lower elevations, vegetation is sparse, and both runoff and sediment yield are higher, although total precipitation is less. Table III-2 provides guidelines for ranking lease tracts by elevation.

5. Current Uses (Step 5)

Proximity of the tract to the nearest public or domestic (non-mine) water use is an important measure of the potential for harm to the human population. Simply stated, the farther away the population is, the better. A public water system has been defined by the Safe Drinking Water Act (P.L. 93-523) as "a system for the provision to the public of piped water for human consumption if such a system has at least fifteen service connections or regularly serves at least twenty-five individuals." Domestic use is defined as water for human consumption. Agricultural use is not included in this definition because irrigation can probably be postponed or interrupted if a temporary water quality problem occurs. Domestic uses, with or without treatment, must continue unless water can be provided from another source. Contaminated groundwater, in particular, might require decades to return to normal or drinkable conditions. Table III-2 presents the values to be assigned to this characteristic for each lease tract. The distance from the lease tract to a city with a public water supply system should be determined from available maps and ranked as shown in Table III-2.

HYDROLOGY WORKSHEET

Percent Recharge

Tract	Characteristics	Assigned Value	Weighted Value (x 0.25)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

HYDROLOGY WORKSHEET

Alluvial Aquifers

Tract	Characteristics	Assigned Value	Weighted Value (x 0.20)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

HYDROLOGY WORKSHEET

Drainage Density

	Characteristics				
Tract	Cumulative Stream Length (L)	Area of Lease Tract (A)	Drainage Density (L/A)	Assigned Value	Weighted Value (x 0.20)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

HYDROLOGY WORKSHEET

Topography

Tract	Characteristics	Assigned Value	Weighted Value (x 0.25)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

HYDROLOGY WORKSHEET

Potable Supply

Tract	Characteristics	Assigned Value	Weighted Value (x 0.10)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

WATER QUALITY WORKSHEET

Aquifers Intercepted

Tract	Characteristics	Assigned Value	Weighted Value (x 0.25)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

WATER QUALITY WORKSHEET

Drainage Basin Intercepted

Tract	Characteristics	Assigned Value	Weighted Value (x 0.20)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

WATER QUALITY WORKSHEET

Overburden Storage

	Characteristics				
Tract	Number of Storage Sites	Storage Volume (10^6 yd^3)	Overburden (10^6 yd^3)	Assigned Value	Weighted Value (x 0.10)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

WATER QUALITY WORKSHEET

Elevation

	Characteristics			Weighted Value
Tract	Elevation Range (ft)	General Elevation (ft)	Assigned Value	(x 0.20)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

WATER QUALITY WORKSHEET

Present Uses

Tract	Characteristics	Assigned Value	Weighted Value (x 0.25)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

HYDROLOGY ELEMENT SUMMARY SHEET

	Weighted Value					
Tract	Percent Recharge	Alluvial Aquifer	Drainage Density	Topography	Potable Supply	Total
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

WATER QUALITY ELEMENT SUMMARY SHEET

	Weighted Value					
Tract	Aquifers Intercepted	Drainage Basin Intercepted	Overburden Storage	Elevation	Present Uses	Total
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

HYDROLOGY/WATER QUALITY IMPACT INDICATOR

	Total Weighted Value		
Tract	Water Quality	Hydrology	Average Value
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

IV AIR QUALITY IMPACT INDICATOR

Intertract comparison of air quality within a particular region is very difficult. Wind data for each tract are rarely available, and plans for mine development will not be available. Consequently, fugitive dust is used as the primary measure of effects on air quality. A study by PEDCo-Environmental Specialists, Inc. (1976) estimated that more than 80% of fugitive dust emissions from mining activities in the Powder River Basin could be attributed to three factors: mining operation, haul road traffic, and wind erosion. Thus, these three elements are good measures of the air quality. Note that these elements are ranked on a relative scale; that is, the lease tract with the best characteristics is ranked at 100 and the other tracts are ranked relative to the first. This approach is different from that used in the previous section, where absolute values (representing minimal, moderate, or major effects) were assigned to each element. Figure IV-1 illustrates the ranking process. Worksheets are located at the end of the chapter.

A. Methodology

1. Mining Operation (Step 1)

Emissions resulting from mining operations depend primarily on the volume of overburden removed. Information on this can be obtained from the Water Quality section. The volume of overburden is divided by the estimated life of the mine to determine the rate of removal. Once the rate of overburden removal has been determined for each tract, the user will rank the tract with the lowest rate of overburden removal at 100. All other tracts will then be scaled relative to the first by a simple proportion.

2. Haul Road Traffic (Step 2)

Annual fugitive dust emissions from traffic on unpaved haul roads depends on the tonnage of coal mined each year, the weight limits of the trucks used, and the length of each haul. Because the length of each haul cannot be determined without a detailed mine plan for each tract, the number of truckloads per year can be used as a surrogate measure to characterize the fugitive dust emissions from haul road traffic.

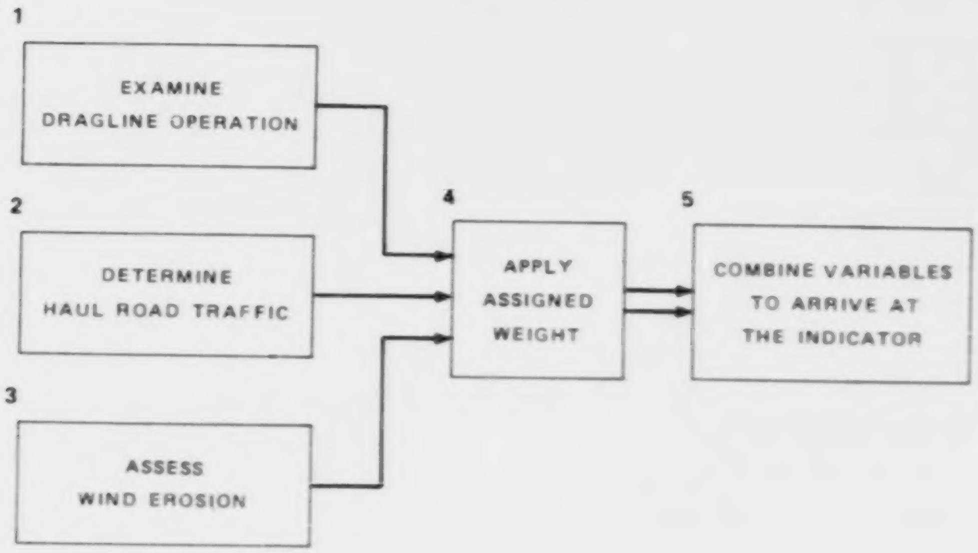
1
EXAMINE DRAGLINE OPERATION
2
DETERMINE HAUL ROAD TRAFFIC
3
ASSESS WIND EROSION
4
APPLY ASSIGNED WEIGHT
5
COMBINE VARIABLES TO ARRIVE AT THE INDICATOR

FIGURE IV-1. APPRAISAL STEPS FOR THE AIR QUALITY IMPACT INDICATOR

After calculating the number of truckloads per year for each tract, the tracts are scaled relative to each other, based on a value of 100 for the tract with the lowest number of truckloads.

3. Wind Erosion (Step 3)

The propensity of a particular tract to wind erosion depends on climate, soil, vegetative cover, and topography. Studies have shown that wind predominates as a natural erosive mechanism when annual precipitation is low (less than 15 inches) and mean annual temperatures are below 20 degrees F or above 60 degrees F (Leopold, Wolman, and Miller, 1964). However, whenever ground cover is disturbed, the potential for wind erosion and fugitive dust emissions increases exponentially. PEDCo (1976) used an equation to estimate annual emissions from a mine. The equation is based on one developed by Woodruff and Siddoway (1965) of the U.S. Department of Agriculture and applies to agricultural acreage.

Because available equations provide little differentiation among sites, the amount of surface area exposed over a 2-year period has been selected as the key characteristic. It is defined as the amount that has been disturbed but not yet revegetated. This quantity can be obtained by dividing the amount of coal produced in 2 years by the recovery factor, (the percentage of the coal actually mined) to yield the quantity of coal originally in the ground. This value is then divided by the thickness of the coal seams to determine the surface area disturbed over 2 years. The tract with the lowest value will be rated 100, and the others will be rated proportionally.

B. Weightings

The weightings to be applied to each element to determine the overall value of the air quality indicator, based on a report by PEDCO (1976), are as follows:

Overburden removal	50
Haulroad traffic	35
Wind erosion	15

AIR QUALITY WORKSHEET

Mining Operations

	Characteristics		
Tract	Volume of Overburden (10^6 yd^3/yr)	Assigned Value	Weighted Value (x 0.50)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

AIR QUALITY WORKSHEET

Haul Road Traffic

	Characteristics			
Tract	Coal Mined (10^6 tons/yr)	Estimated Truckloads (10^3/yr)	Assigned Value	Weighted Value (x 0.35)
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

AIR QUALITY WORKSHEET

Wind Erosion

Tract	Characteristics Surface Area Exposed (acres/year)	Assigned Value	Weighted Value (x 0.15)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

AIR QUALITY IMPACT INDICATOR

	Weighted Value			
Tract	Mining Operation	Haul Road Traffic	Wind Erosion	Total
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

V BIOLOGICAL IMPACT INDICATOR

A. Introduction

To rank alternative coal lease tracts with respect to the biological acceptability of mining, three elements are important: first, the legal or administrative constraints, such as designation of a site as a wilderness area; second, the potential to restore the premining biotic communities (or an equally desirable alternative); and third, the significance of the exclusion of biota from the tract or adjacent areas during mining. These elements are included in the appraisals of potential impact on western coal lands published by the U.S. Fish and Wildlife Service in a series of five documents under the general title of "Ranking of Wildlife on Federal Coal Lands" (U.S. Department of the Interior, 1977). These assessments are currently the most reliable standardized assessments, and their use in the methodology described in this report is described in Section C.1 of this chapter.

A default procedure described in Section C.2 should be used if the sites to be ranked are outside the areas covered by the Fish and Wildlife Service ratings, or if these ratings are no longer current when the comparison is made and cannot be readily updated. The criteria used for ranking in the default procedure roughly paralles the criteria used by the Fish and Wildlife Service in its ranking, and partially cover the excluson criteria reviewed by Steward (1978). Criteria cited by Steward that are not covered here are covered in other chapters, as appropriate. The criteria included in this chapter apply primarily to terrestrial habitats because several of the criteria pertinent to aquatic habitats are included under water quality (Chapter III). The steps followed in the default procedure are diagrammed in Figure V-1. Worksheets for this default procedure are included at the end of the chapter.

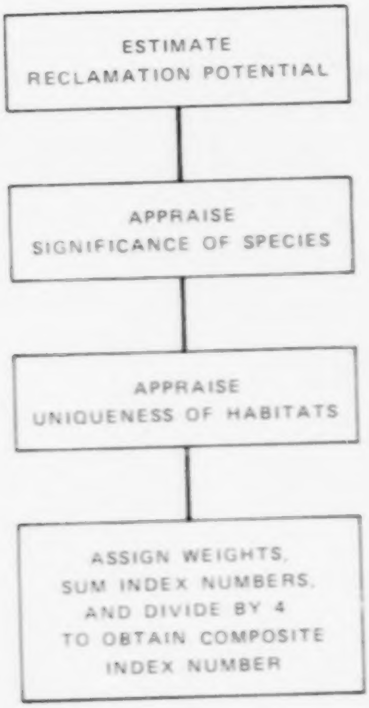
ESTIMATE RECLAMATION POTENTIAL
APPRAISE SIGNIFICANCE OF SPECIES
APPRAISE UNIQUENESS OF HABITATS
ASSIGN WEIGHTS, SUM INDEX NUMBERS, AND DIVIDE BY 4 TO OBTAIN COMPOSITE INDEX NUMBER

FIGURE V-1. APPRAISAL STEPS FOR BIOLOGICAL IMPACT INDICATOR (DEFAULT METHOD)

B. Data Sources

Appraisals of the overall wildlife value of lands in the major western coal fields have been developed by the office of Biological Services of the U.S. Fish and Wildlife Service, as noted above. These appraisals rate the suitability of sites on a section-by-section or quarter-section basis. Sites are ranked on a scale from 1 to 4 that represents the integration of assessments of the status of endangered species, the status of threatened species, the importance of species of higher interest, and the potential for restoration, reclamation, and mitigation. These overall ratings are presented in both graph (map) and table for coal lands in Colorado, Montana, North Dakota, Utah, and Wyoming (U.S. Department of the Interior, 1977). Staff of the Fish and Wildlife Service's Region 6 or the Fish and Wildlife Service's Western Energy and Land Use Team (WELUT) should be contacted for appraisals of the currency of this data base or for any necessary details regarding the integration of the ratings for the four criteria used.

Data on the distribution of legally protected animals can be obtained from the federal resource management agencies, state environmental or game management agencies, environmental organizations, and university taxonomists. Regional offices of the U.S. Fish and Wildlife Service, the Bureau of Land Management, the Bureau of Reclamation, the U.S. Forest Service, the U.S. Army Corps of Engineers, and the Soil Conservation Service, or the equivalent state agencies, are generally the most convenient sources of these data. Data on plants of special interest are obtainable from these same sources and from a few specialized data bases, particularily the U.S. Fish and Wildlife Services Plant Information Network (PIN), and those of the Smithsonian Institution.

Data on the availability of native plants for reclamation and rehabilitation of lands in northwestern Colorado and the Powder River Basin can be obtained from PIN (Vories and Sims, 1978). Coverage may be extended in the future as funds permit. WELUT staff should be consulted for more recent dates. Complementary programs are operated by the Soil

Conservation Service (Plant Materials Center), the U.S. Forest Service, and other land management agencies.

C. Methodology

1. Preferred procedure

Ratings for individual sites should be obtained from the Fish and Wildlife Service's 5-volume series, "Ranking of Wildlife on Federal Coal Lease Lands," if the sites to be ranked are covered by this series, and if the appraisals are still current. Because the details of the assessment process are not given in the published reports, verification of their currency will require consultation with the Fish and Wildlife Service Region 6 staff. If these ratings can be used, the ratings of the Fish and Wildlife Service should be multiplied by 25 to make them compatible with the methodology used in this report and the products used in subsequent steps (Chapter VIII).

2. Default Procedure

If the Fish and Wildlife assessments are no longer current and cannot be updated by means of consultation with the Fish and Wildlife Service or other resource agencies, the following procedure provides an alternative means of rating the biological significance of the sites.

a. Reclamation Potential (Step 1)

Reclamation potential is evaluated with Packer's index of rehabilitation potential (Packer, 1974), an index value derived from the most applicable soils and climatic data. This index is the algebraic sum of indices of the potential productivity of a site (based on average annual rainfall), soil type, and an index of the availability of suitable seed stock for restoration of the original vegetation. The values assigned to each vegetation type by Packer were based on expert judgment of the then current technology and the seed market in 1973-1974, but may be readily updated by information from the PIN, local agricultural extension agents, or mine reclamation experts. The seed availability index, the only factor that is subject to rapid change, should be deleted or updated when this methodology is updated. In either case, the higher the index value, the more readily reclaimed the site, and the broader the land manager's range of options for postmining use of the site. The published indices are only applicable in the Northern Great Plains but extensions to other regions are in progress.

If the site to be evaluated is covered by Packer's published work, use Table V-1 to transform Packer's index values to a 5-100 scale compatible with the methodology used in this report. If the site is not covered, the reclamation potential can generally be approximated by the generation of simplified scales based on the highest and lowest values for rainfall and soil fertility within the set of lease tracts under consideration. Appendix A illustrates how these scales or indices can be developed and used.

b. Significance of Species (Step 2)

Species which are legally protected by state or federal law, would require action beyond the authority of the staff who are expected to be responsible for the initial ranking of tracts. Consequently, tracts containing plant or animal species that are protected by federal or state law or are candidates for such protection will be given an index value of 1 and should be marked as requiring attention at later stages of decision making if these tracts are not otherwise eliminated from consideration during the ranking process. At present such sites are excluded from consideration for leasing (Steward, 1978). Tracts without legally protected species or species of special interest should be assigned a value of 100. If such species are present, the values should be determined from Table V-2, the lowest value obtained should be applied to the site.

Table V-2 requires that users define "rare" and "local" for themselves. In practice, "rare" species might best be defined as those designated as such by government agencies, conservation groups, or academicians. Similarly, "local" will have to be defined in terms of the mobility of the organisms. In the absence of a specific definition, "local" might be defined as an area with a radius of 20 miles or less.

Table V-1

TRANSFORMATION OF PACKER'S COMBINED RATING TO A 5-100 SCALE

Packer's Rating	Transformed Rating
+9	95
+8	90
+7	85
+6	80
+5	75
+4	70
+3	65
+2	60
+1	55
0	50
-1	45
-2	40
-3	35
-4	30
-5	25
-6	20
-7	15
-8	10
-9	5

Source: Packer, pp. 28, 29 (1974).

Table V-2

INDEX VALUES FOR SPECIES OF CONCERN

A. Legally protected species	1
B. Unprotected species	
1. Reductions in population size	
None	25
Some	10
Significant (50% or more)	5
Extinction of local population is probable	1
Population size unknown/impacts unknown	1
2. Vulnerability of habitat to loss or change	
None	25
Some	10
Will be significant	5
Will be total	1
Unknown	1
3. Population concentration	
Never concentrated	25
Sporadically	15
Regularly in several locations	10
Regularly in one location	1
Unknown	1
4. Potential for recovery	
Habitats will be continuously available	25
Habitat availability uncertain or unknown	15
Habitat availability on adjacent lands	1

Source: Modified from Sparrow and Wight (1976).

Federally protected species include federally listed endangered species, state listed endangered species, and certain other species whose habitats are protected, such as the golden eagle, wild burros, and migratory birds. In addition, species of special interest because of their recreational value, status as game animals, or scientific interest should be appraised using Table V-2. The statutory authority for the protection of federally protected species is summarized by Steward (1978).

C. Uniqueness of Habitats (Step 3)

Each coal lease tract is unique, but the significance of the features that make it unique often are not readily quantified. A site may have significant biological value because of an uncommon juxtaposition in it of habitats that are individually quite common. Significance may also derive from apparently arbitrary, historical factors exemplified by the use of relatively small numbers of breeding grounds by grouse. Uniqueness may also derive from an absence of prior disturbance by man or from the presence of scientifically interesting variants of a common species.

If one site meets one of the proposed Department of Interior unsuitability criteria (Table V-3), assign it a value of 1. If none of these criteria apply, derive a rating from Table V-4 by rating the site with respect to each of the 24 items and summing the ratings for these 24 items to obtain an overall rating.

Alternatively, Table V-4 can be used to estimate ratings of uniqueness if each of the four items is rated and the four then summed to obtain a single value.

d. Integration of Biological Indicators (Step 4)

The index values for reclamation potential, species rarity, habitat uniqueness, and the potential for recovery of plant and animal populations should be summed and divided by three to obtain an overall index value for biological impact.

TABLE V-3

SUITABILITY/UNSUITABIITY CRITERIA OF THE DEPARTMENT OF THE INTERIOR

1. Selected federal lands systems
2. Rights-of-way and easements
3. Buffer zones along rights-ofway and adjacent to communities
4. Wilderness study areas
5. Scenic areas
6. Lands used for scientific studies
7. Historic lands and sites
8. Natural areas
9. Federally listed endangered species
10. State-listed endangered species
11. Bald and Golden eagle nests
12. Bald and Golden eagle roost and concentration areas
13. Falcon cliff nesting sites
14. Migratory birds
15. State resident fish and wildlife
16. Wetlands
17. Floodplains
18. Municipal watersheds
19. National resource waters
20. State lands unsuitable
21. State proposed criteria
22. Prime farm lands
23. Alluvial valley floors
24. Reclaimability

Source: Stewart (1978)

Table V-4

UNIQUENESS RATING

Presence of at least one uncommon animal habitat (e.g., inland salt marsh)

Everything common	25
Locally[a] rare or uncommon regionally[b]	10
Rare regionally[b]	5
Rare nationally	1

Presence of preferred habitat for at least one legally protected species or species of special interest

Everywhere common	25
Locally common but uncommon regionally	10
Locally uncommon	5
Locally rare	2

Presence of at least one habitat useful for scientific study

Heavily modified (e.g., overgrazed lands)	25
Moderately modified (e.g., average grazing)	10
All areas slightly modified (e.g., lightly grazed)	5
Pristine environments present	1

Presence of at least one exceptional habitat or combination of habitats not otherwise considered

Nothing exceptional	25
Locally exceptional	10
Regionally[b] uncommon habitat combinations or species diversities	5
Exceptional everywhere encountered	1

---

[a] Locally is arbitrarily defined as an area with a 20-mile radius.

[b] Region here denotes an ecoregion of Bailey (1976).

WORKSHEET FOR BIOLOGICAL IMPACT INDICATOR

Tract No. ____

1. Reclamation potential[a]
   a. Table V-1 ____
   b. Alternative Table (see text) ____ ____
   Notes:______________________________

2. Important species (Table V-2) ____
   Notes:______________________________

3. Habitat Uniqueness[a]
   a. Expert opinion ____
   b. Table V-4
      Commonness ____
      Criticality ____
      Scientific value ____
      Combinations ____
      Sum of above four items ____ ____
   Notes:______________________________

4. Total of items 1-3 ____

5. Divide total by 3 ____

6. Adjustments of line 5[b] ____

7. Additional Comments:______________________________

____

____

---

[a] Use only one of the two methods, for compiling the data

[b] Justify any adjustments other than rounding to two significant digits.

VI SOCIOECONOMIC IMPACT INDICATOR

A. Introduction

The socioeconomic elements chosen are those considered to be the most seriously affected in rapidly growing communities. These elements can provide insight into the possible impact of coal mining on the lives of both present residents of communities near the mines and newcomers to those communities. The six elements chosen for analysis are population, social services, community economic structure, bonding capacity, private economic activities, and housing. These elements were chosen for several reasons. They were considered significant in previous studies of boomtowns and energy-impacted communities. These studies, which are listed in the bibliography, analyzed socioeconomic changes in communities that had experienced rapid increases in population. Severe impacts on several areas, including housing, social services, and health services, were mentioned repeatedly. A report by the Federal Energy Administration on energy-impacted communities also cites effects on all of these elements as important areas of concern. Although the methodology is intended to call out possible negative impacts as a kind of early-warning system, while performing the analysis it is worth keeping in mind that coal mining may have some offsetting positive impacts as well.

Some of the elements, particularly population and social services, are complex, and breaking them down into their components will enable a more complete analysis to be made. Analysis of all the elements will provide enough information to characterize the potential effects of coal mine development on communities as severe, moderate, or light (see Figure VI-1).

Ratings of significance have been assigned to each element in a slightly different manner than that used in previous sections. The

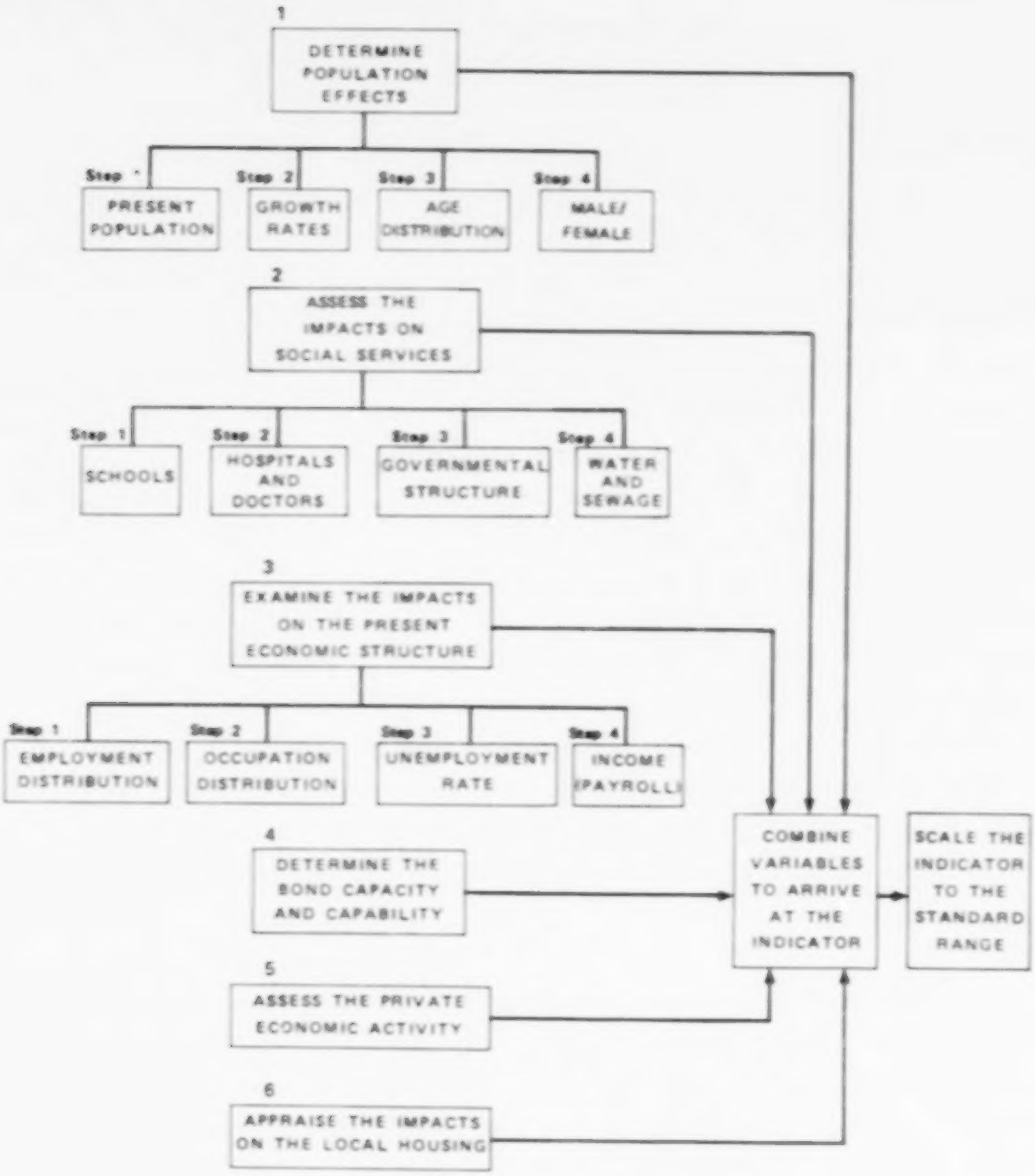
1
DETERMINE POPULATION EFFECTS
Step 1
PRESENT POPULATION
Step 2
GROWTH RATES
Step 3
AGE DISTRIBUTION
Step 4
MALE/ FEMALE
2
ASSESS THE IMPACTS ON SOCIAL SERVICES
Step 1
SCHOOLS
Step 2
HOSPITALS AND DOCTORS
Step 3
GOVERNMENTAL STRUCTURE
Step 4
WATER AND SEWAGE
3
EXAMINE THE IMPACTS ON THE PRESENT ECONOMIC STRUCTURE
Step 1
EMPLOYMENT DISTRIBUTION
Step 2
OCCUPATION DISTRIBUTION
Step 3
UNEMPLOYMENT RATE
Step 4
INCOME (PAYROLL)
4
DETERMINE THE BOND CAPACITY AND CAPABILITY
5
ASSESS THE PRIVATE ECONOMIC ACTIVITY
6
APPRAISE THE IMPACTS ON THE LOCAL HOUSING
COMBINE VARIABLES TO ARRIVE AT THE INDICATOR
SCALE THE INDICATOR TO THE STANDARD RANGE

FIGURE VI-1. APPRAISAL STEPS FOR THE SOCIOECONOMIC IMPACT INDICATOR

components of each complex element have been assigned a maximum number of points on the basis of their relative importance. These points add up to 100 for each element. To be consistent with other rankings in this report, communities that will be least affected will receive the largest number of points. Remember to total the points at the end of each section to obtain the overall ranking. The totals for all the elements are then added and divided by 6 so that socioeconomic effects will receive the same emphasis as the other indicators.

Under the discussions of elements and their components, instructions are given for assigning points for possible effects of coal mine development. Sample worksheets have been been provided to help the user assemble the necessary information.

B. Determination of Ranking

These numbers become factors in the analysis of the desirability of developing potential coal lease tracts. They should be applied to the proposed lease tract by proximity; that is, the city or community closest to the lease tract will probably be much more seriously affected. Expert judgment must be used to apportion the effects if more than one community is located near the tract or the community closest to the tract is undesirable and there is a desirable one within commuting distance. (See the test case in Appendix A.)

C. Data Sources

Data sources have been listed in the bibliography, Appendix C. The data in many of these sources may be specific to the region they cover (northwestern Colorado), but they are cited to suggest the kinds of materials that are available to provide a basis for an analysis of socioeconomic indicators.

D. Methodology

1. Population

The human population of the area is one of the primary elements that will help determine how coal mining will affect nearby communities.

Several different components of the population element are important to consider.

a. Present Population (Step 1) -- Many of the coal leasing sites are near very small farming or ranching communities of between 100 and 1,000 persons. When the starting population is very small, the impact of operating even one coal mine could be significant because smaller communities are generally less able than large ones to absorb a large influx of new workers and their families. The original base population is therefore a very good indicator of a community's ability to absorb the new population.

Points are assigned to this component according to the size of nearby communities. Two factors should be considered: the number of communities within a 25 mile radius of the lease tract, and the number of people residing in each community. Determining the impact is closely related to the population of the affected communities. In measuring the significance of the impact it is necessary to remember that many of these communities are very small and would be seriously affected by a large influx of people.

The base population is assigned 30 of the 100 points for the population indicator. The points should be distributed as shown:

Base Population	Points
1-1,000 persons	0
1,000-5,000	15
5,000 and above	30

b. Growth Rates (Step 2) -- A community's ability to absorb new people depends not only on how many people enter it, but also on how rapidly they enter. For example, if 600 people arrived in a single week in a community of 500 people, impact on the community's support services, as well as on its housing, traffic patterns, and noise levels, would be intolerable. The community could handle the problems better if the growth occurred over a longer time period or if it could prepare in advance for the arrival of the new people.

To assign points to this component, several steps are necessary The factors to be considered include the historical growth rate and the projected growth rate. The projected growth rate for an area should be calculated by estimating the number of miners from outside the region, multiplying this number by a factor to account for families and support workers, dividing by the present population to obtain the percentage increase, and assuming that this growth would occur during a period of 2 years.

The number of support personnel needed would vary with the size of the base population. Small farming communities of less than 5,000 people would require more support personnel than a larger community with a more diverse economic base. A multiplier is used to determine the number of people who would come into a community for each miner hired. For communities with less than 5,000 persons, a multiplier of 5 should be used. For communities with a population of 5,000 or more, a multiplier of 3 should be used. These multipliers provide very general indications of the differences in the effects of a mining operation on communities of different sizes.

The projected growth rate is a very important indicator of how severly the community will be affected by coal mining. Thirty of the 100 population points have been allocated to it. These points should be assigned as follows:

Annual Growth Rate	Points
1-3%	30
3-5%	20
6-10%	10
Over 10%	0

c. Age Distribution (Step 3) -- The age structure of a community is important because it will affect how well new workers and their families would interact with the existing population and how easily they could be integrated into the community. For example, an influx of miners and their families would have a dramatic effect on a retirement community. Table VI-I presents the current U.S. national age distribution and median age.

Several kinds of information are necessary. First, ascertain the present age distribution of the affected communities (or the county, if community figures are not available). Find examples of age distribution changes in a rural community after a coal mine (see Figure VI-2). Then determine the typical age characteristics of mine workers and their families.

Using data from past examples, project the number of people of various ages that will enter a community. These figures can then be added to the most current age distribution pyramid of the community to determine where important changes will occur.

The significance of the impact will be judged by comparing age distribution pyramids. An age and sex pyramid of an energy impacted area before and after the "boom" are included in this handbook. This pyramid will be compared to current pyramids of the particular community and the example pyramid that illustrates the changes likely to follow the development of a lease tract (see Figure VI-2). The significance of the impact increases as the growth becomes more unbalanced, particularly if the majority of the new population will be in one or two age groupings. This aspect of the population indicator was given 25 of the 100 points. They should be distributed as follows:

Growth Distribution	Points
Evenly distributed	25
Fairly evenly distributed	15
Disproportionately distributed	0

Table VI-1

UNITED STATES AGE DISTRIBUTION[a]

Age Group	Percentage of the Population
Under 5	8%
5-13	16
14-17	8
18-21	8
22-24	5
25-34	14
35-44	11
45-54	11
55-64	9
65 and over	10
Median Age	28.7 years

---

[a] The number of males and females in each age group is almost equal. the only exception is the 65-years-and-older category in which the women outnumber the men three to two.

Source: U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, 1975.

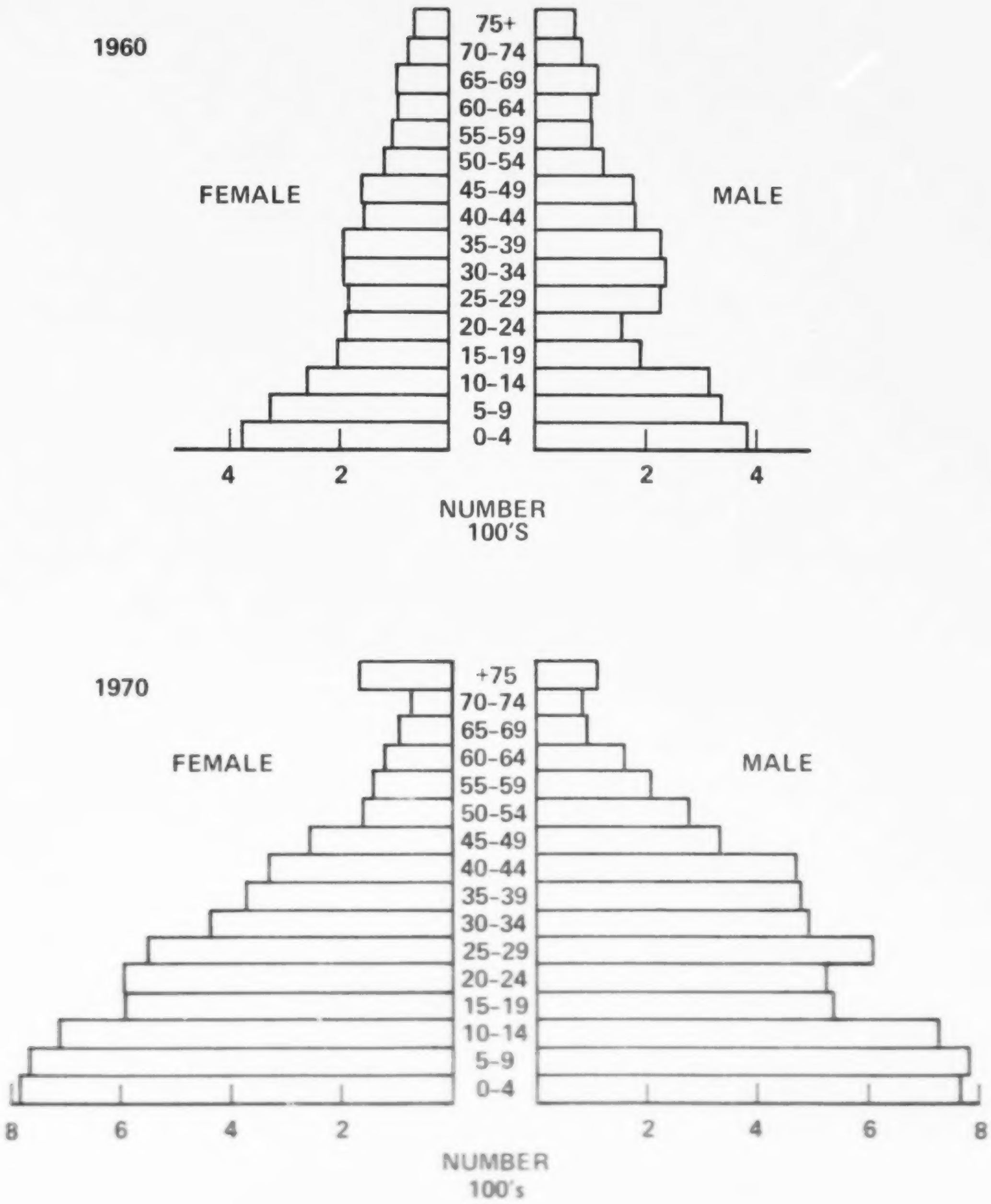

FIGURE VI-2. AGE GROUP PROFILES OF CAMPBELL COUNTY, WYOMING, 1960 AND 1970

THE CHANGE IN AGE DISTRIBUTION OF THE POPULATION IS READILY APPARENT

d. Male/Female Ratio (Step 4) -- A balance of men and women in the community is desirable. Most communities are fairly evenly balanced and the issue never surfaces as a problem. However, many of the boomtown studies of mineral extraction areas have found that a significant male/female imbalance can have detrimental social effects. For example, in Rock Springs, Wyoming, after the boom, men outnumbered women 10 to 1, and prostitution was common. A significant change in the existing sex ratio can be an undesirable effect of coal development. For comparison, the current U.S. male/female ratio is approximately 49/51.

Determination of the effects requires a consideration of the normal sex balance (national, state, county), and estimating the male/female ratio of the coal mine workers and their families. (This may be determined from previous studies and company records of miner's family characteristics.)

Add the number of men and women expected to enter the community to the number already residing in the community. Determine the difference between the new ratio and the old, as well as the difference between the new ratio and state and national norms. The change within the community should be used to determine the impact. The other differences are included to provide a norm to be used for comparison.

This aspect of population has been assigned 15 of the 100 population points. They should be distributed as follows:

Ratio Change	Points
0-15%	15
15-30%	8
greater than 30%	0

e. Total Points for Population Section (Step 5) -- Add the points together to obtain a ranking for the section component (use worksheets to determine points).

2. Social Services

The social services element is a measure of the adequacy of schools, hospitals and doctors, governmental structures, and water and sewage treatment facilities. Such services are generally maintained at a level that meets or exceeds the needs of the community, although services are limited in most small rural communities. Small communities tend to compensate for limited services by informal social networks and organizations.

A rapid increase in population could have a very significant impact on this delicate balance. Services could become so overloaded that they would be unable to meet the needs of the residents, old or new. This phenomenon has been documented repeatedly in boomtown studies (Gilmore, 1976). A disruption in social services may also cause worker dissatisfaction, reduce the "quality of life," and increase social stress.

a. Schools (Step 1) -- The number of classrooms and teachers is gauged to the current size of the community. A sudden increase in the number of students can decrease the quality of education for an extended period of time; new sources of funding are required before steps to solve the problem can begin, and building classrooms is time-consuming. Both old and new residents would be affected by the strain on the existing teachers and the facilities.

To determine points for this component, it is necessary to know the current number of students, teachers, and classrooms, and the projected number of new students. (For a minimum estimate, assume that for every two workers, there is one child. Refer to the population section to obtain the number of workers.) Subtract the number of new students from the spaces available in the schools. A number greater than zero indicates that available classroom space is adequate. Adequate classroom space is very important because of the cost of building new schools and the time required to complete construction. The number of teachers can be adjusted more quickly, and doing so is less expensive. The need for new teachers is an important consideration, however, in remote communities because there are some difficulties associated with hiring. Nevertheless, the impact would be most significant when new classrooms are required. The number of new classrooms needed can be estimated, by assuming 25 students per room. Determine whether the number of classrooms is adequate for the expected enrollment.

Thirty points have been assigned to this element. They should be distributed as shown:

New Classrooms Required	Points
No new classrooms	30
1-4 new classrooms	20
4 or more new classrooms	0

b. Hospitals and Doctors (Step 2) -- Many small rural communities do not have hospitals, doctors, or dentists. The residents must often travel 50 miles or more to a doctor, perhaps further to a hospital. Health care is barely satisfactory, and the condition could be made temporarily worse by a rapid increase in population which would further increase the ratio of patient to doctors as well as decreasing the ratio of beds to patients in a hospital.

This condition could improve over time as services catch up with demand and the community is able to attract more doctors and dentists and to enlarge hospital facilities. However, isolated rural areas often have difficulty attracting medical personnel. Neither population growth in rural regions nor an increase in regional income has guaranteed that more dentists, physicians, or surgeons will move into an area (R. Parker and Tuxell, April 1967; J. Hambleton).

To assign points for this factor, determine the current number of persons per doctor and dentist, and the adequacy of the supply of hospital beds per 1,000 people. On the basis of estimates of how many people would be added as a result of coal development (refer to the population element), calculate what the new ratios would be, and compare them to the current ratio in the particular county or state (the county or state health department should be able to supply this information). Compare the current and projected numbers of persons per doctor in the coal lease area with the ratio obtained from either the county or state health department. Similarly compare current and projected ratios of population to number of available hospital beds. Twenty points have been assigned to this indicator. Assign the points as follows:

Comparison with Standard Ratios	Points
Services are close to adequate	20
One exceeded by 50%	10
Both exceeded by 50%	0

c. Governmental Structure (Step 3) -- A community's ability to deal with day-to-day as well as long-term problems depends on its governmental structure. The government has the responsibility of ensuring that community problems are solved and that the community is a pleasant place to live. Community governments accomplish this by delegating responsibility and by planning, budgeting, and meeting directly with the citizens to determine their needs and desires.

In a small community, the formal governmental structure usually consists of a part-time mayor, sometimes supplemented by a planner or an engineer. Many problems are solved through informal communication. Zoning ordinances, building codes, and subdivision codes are usually found only in communities with more elaborate governmental structures. These codes are often considered unnecessary by the residents of a small town. On the contrary, they consider them to be infringements of their rights. For these reasons, it is clear that many communities are simply not prepared for rapid growth. The community cohesiveness and casual structure are destroyed by growth, and governmental services are thereby disrupted. Without an adequate staff, it is nearly impossible for community leaders to direct and control growth.

The effects of a coal mine will be closely related to the available planning expertise; that is, the size and composition of the governmental staff. Communities without planners and engineers that have only a part-time mayor or town manager would be least able to control new growth. With an increasing number of planners, engineers, and others trained to deal with growth, the chance that growth will be uncontrolled decreases.

This component of social services should be assigned points on the basis of the current staff.

Present Personnel	Points
Mayor, Planner, and Engineer	25
Mayor and Planner	15
Mayor	0

d. Water and Sewage (Step 4) -- The ability to provide water and sewage treatment is critical. If a community grows faster than its capabilities grow, water rationing could become necessary. If sewage treatment is inadequate, diseases and other health problems could result. Both of these services could easily become overextended as a result of a large population increase in small rural communities. Because sewage treatment facilities are large and require extended periods of time for construction, delays in obtaining adequate capacity could be lengthy.

The impact of a coal mine will depend on such factors as average daily use of water, total amount of water available daily, type and capacity of available sewage treatment facilities, and amount of sewage generated per person per day. The availability of water is critical if more than 10-15% of the supply would have to rationed to meet the needs of the community. Sewage treatment would be a critical issue if it were currently being used at capacity or if its capacity would be exceeded by an influx of people.

Points are assigned according to the amount of service currently available:

Current Water and Sewage Facilities	Points
Adequate (room for growth)	20
Barely adequate (shortage inevitable)	10
Already inadequate	0

e. Total Points (Step 5) -- Add the points from each step to obtain a social service ranking for the community (use worksheets to determine points).

3. Present Economic Structure

The present economic structure, particularly of a small rural community, would be greatly affected by the opening of a coal mine nearby. The economic base in many small communities is ranching or farming. When a community has one major industry, most of the services, as well as the income levels, are directly related to this industry. The occupational distribution and the unemployment level are related to the existing job market, which reflects the dominant industry. The opening of a coal mine would change the occupational distribution of the community. There would be some beneficial effects -- the creation of new job opportunities, for example. However, these new job opportunities, usually at higher wages, often draw employees away from the ranches and farms, leaving them short of labor. This situation can improve with time as more people are attracted to the area. However, farmers, who were the main employers before the mine opened can suffer from an inadequate labor force.

To determine the impacts of a coal mine, several aspects of the present economic structure will be examined in more detail: employment distribution, occupational distribution, unemployment rates, and income. The points assigned to each will be determined by their relative importance.

a. Employment Distribution (Step 1) -- Many small towns have a limited job market with little variety in employment opportunities. Many boomtowns, such as Gillette, Wyoming, were little more than rural farming communities before the resource development began. The development not only directly expanded employment opportunities, but also stimulated new jobs in the service sector.

Recently, mining operations near Gillette, for example, became the dominant industry and have significantly changed the employment distribution from one dominated by farming and ranching to one dominated by mining-related activities and the service industries that the mines require.

The points assigned to this component will be determined by comparing current employment with the amount of employment that would be generated, directly and indirectly, by coal mine development. Major employment categories and the number of employees in them will have to be taken into account.

To determine the impact, calculate the total number of employees by adding the employment under the major categories (wholesale and retail trade, construction, government, and so on). Then subtract the mine-related employment (multiply the number of mine employees by 2) from this total. This multiplier is a "rule of thumb" to be used for small rural communities. For larger communities which already have a well-established infrastructure the multiplier would be smaller. "Expert" judgment should be used here.

The mining operation could be one of the largest employers in the area, which would have a significant impact on employment distribution. Employment directly and indirectly related to coal mining is not permanent, it lasts only as long as the mine is open. the opening and closing of a mine can result in a boom-bust cycle if coal mining dominates the economy of a community. Therefore, a community with a large and diverse employment distribution would be best equipped to cope with the employment impacts related to a coal mine. The points should be distributed according to the proportion of the workforce that would be mine-related.

Mine-Related Employment as a Percentage of the Total Community Employment	Points
0-20%	25
20-40%	15
40% or more	0

b. Occupation Distribution (Step 2) -- Rural towns tend to have a limited occupation distribution. A small town generally has one primary economic activity, such as farming and ranching, and the occupation distribution reflects this limited economic base. Opening a coal mine could radically change the occupation distribution, particularly if the original base population is very small. New jobs would be created, and people would switch from lower paid jobs, such as being "ranch hands," to jobs as miners, as they did in Mercer County, North Dakota. Job switching can have very significant effects in areas where labor is scarce. Many times the vacant positions are hard to fill. If the mine were near a large metropolis, there would be a larger, more diverse distribution of occupations, and job-switching would cause less serious problems. Job switching will also occur less frequently if very few people have transferable skills. If this were the case, it can be assumed that most of the workers would have to be imported.

Assigning points for this component involves determining how likely workers are to leave their current jobs to work in a coal mine. This will be related to the existing occupation distribution and the occupation distribution of direct and support mining employment. Compare the previous occupation distribution with the occupation distribution of the mining operation and the secondary employment it induces.

The impact of the new jobs would be the least in communities with very little correlation between the current occupation distribution and that of coal mining because there would be little diversion of the work force from other employment. The points will be assigned according to the correlation between the available jobs skills and those required for the mine operations. In some cases when data is limited, this would require talking with the local mayor or someone who is knowledgeable about the economics of the community.

Degree of Correlation	Points
No correlation	30
Some correlation	15
Very similar	0

c. Unemployment Rate (Step 3) -- The rate of unemployment is an indicator of the number of people who are readily available for new jobs stimulated by the mining industry. If unemployment is high, more labor will be available locally.

Points can be assigned for this component according to how much a coal mine can be expected to reduce the unemployment rate. First, determine the unemployment rate in the nearby communities. Then compare the number of unemployed people with the number of jobs that would be generated.

If the ratio of mine-related or induced jobs (as determined in the employment distribution section) to the number of unemployed persons is high, there is a good chance that unemployment in the region can be significantly reduced. This effect constitutes a socioeconomic benefit. The points will be distributed on the basis of the ratio of mine-related or induced jobs to the number of unemployed persons.

Ratio of Mine-Related Jobs to Number of Unemployed Persons	Points
Considerably greater than 1	35
About 1	20
Considerably less than 1	0

d. Income (Payroll) (Step 4) -- The employment stimulated by the mining industry will generate income in the form of payroll. This income affects the area directly by adding new money to the local economy. The effects will depend on the current total income of the community and the total income generated by direct mine employment (average of $2.4 million for 160 workers). Compare these two levels of income. Take into consideration that a great deal of income will also be generated by the induced employment.

If the income generated by the mining industry, directly and indirectly, is a large percentage of the current income or generates a substantial portion of the community payroll, it is considered significant. Points should be assigned as follows:

Percentage of Income Generated by Coal Mines	Points
Above 25%	10
10-25%	5
0-10%	0

e. Total Points (Step 5) -- Add the points from each step together to obtain a ranking for the community (use the worksheets to determine the points).

4. Bond Capacity

A community's bond capacity is its ability to generate money to pay for capital improvements such as schools. This ability becomes especially important if a community must make improvements or expansions to accommodate new growth. Without an adequate bond capacity, a community would be unable to make the necessary improvements to maintain the quality of life. An inability to make these improvements could lead to crowded schools, poor streets, and delays in providing other capital improvements. The importance of this effect is discussed in two reports (FEA, 1977, and Dickson, et al., 1976).

The method of assigning points for this indicator is simple, but it requires making estimates of capacity and needs. The user must determine the maximum bond capacity remaining and then estimate the extent of the requirement for new capital improvements. Compare the approximate costs of growth with the ability to pay for them. The total capital requirement should be compared with the unused bond capacity of the nearby communities, which can be obtained from documents such as that published by FEA (1977).

The significance can be determined by the shortfall in bond capacity to pay for needed improvements. The points will be assigned as shown. Many times the comparison will be obvious if several services need upgrading and very little bonding capacity remains.

Bond Capacity	Points
Adequate bond capacity	100
Marginal capacity (can meet some but not all needs)	50
Little or no remaining bond capacity	0

5. Private Economic Activity

Private economic activity refers to all nongovernmental services provided to meet the various needs of the community. The major types of establishments are retail stores, such as hardware, clothing, and grocery stores; recreational establishments, such as bowling alleys, movie theaters, golf courses, and private tennis and swimming clubs; and other commercial establishments, such as cleaners, laundries, beauty salons, and barber shops. These establishments fulfill various needs or desires of the residents. Although most are not critical to survival, they do make life more pleasant. Many small rural towns lack many of these recreational and commercial establishments and must rely on large communities nearby or do without these services. As a community grows, so does the demand for various services, particularly if the newcomers are accustomed to having them. These needs can often be met if large communities are nearby.

Points can therefore be assigned on the basis of the size of nearby towns and how far away they are. The impact will be determined by the size of the nearest communities within a 50-mile radius. The extent of available service can generally be correlated to population size. To provide services for the anticipated influx of people, it is generally necessary to have a community of at least 25,000 people within a 50-mile radius of the impacted community.

The significance of the impact is directly correlated with the size of the nearby towns. Points should be assigned as shown:

Size of One Town Within 50 Miles	Points
25,000 or more persons	100
15,000-25,000 persons	40
15,000 persons or less	0

6. Housing

In all the communities analyzed by the FEA (1977), a shortage of housing was one of the most serious problems. The study found that housing shortages affect individual productivity, worker turnover rates, and acceptability to workers of the living environment in energy-impacted communities. The need for additional housing is generally filled with mobile homes. This solution can cause further problems in communities that do not have well-designed housing development plans. Even where mobile home parks have been developed, sheer numbers may be a problem. A previous study (Dickson et al., 1977) found that mobile homes to house new residents had created serious difficulties in the community of Gilette, Wyoming. The mobile homes were scattered randomly throughout the community, creating a very disorganized living environment. Also, because mobile home owners were not required to pay property taxes, they were a financial drain on the community, because they used services but did not increase city revenues.

Although many characteristics will affect the community's satisfaction with local housing, effects can be roughly determined by comparing the available supply of housing with the projected demand. Determine the current vacancy rte, the number of units available, and the types of units available (single-family dwellings, apartments, and so forth. Compare the amount of housing needed for the incoming population with the amount currently available.

The significance of the impact is directly proportional to the housing need that can be filled by available housing stock. Points should be assigned as follows:

Average Ratio of Housing Supply to the Demand for Housing	Points
Considerably greater than 1	100
About 1	50
Considerably less than 1	0

7. Summary

Once all of the socioeconomic indicators have been assessed, record the points scored by each community in the table below. The community which is closest to the lease tracts is assumed to receive the impacts. (An example is presented in Appendix A).

Socioeconomic Summary Sheet

Indicators	Town A	Town B	Town C . . .
Population			
Social services			
Present economic structure			
Bond capacity			
Private economic activity			
Housing			
Total divided by 6*			

---

*Divide the total by 6 to equalize the ranking with the other indicators.

SOCIOECONOMIC IMPACT WORKSHEET

City:__________________. County:__________________.

Worksheet for Part 1: Population.

A. Present Population

Community (impacted) population __________

Any others within 25 mi radius:

__________________________ __________
__________________________ __________
__________________________ __________
__________________________ __________

Points __________

B. Growth Rate

Historical Growth Rate ______________________________
Projected Growth Rate ______________________________

$\frac{\text{number of workers (direct and induced)}}{\text{present population}}$ = ____% (total growth rate) ÷ 2 (the number of years) = ___% projected rate per year.

Points __________

Comments: ____
____
____

C. Age Distribution

Compare:
- present (or most currently available) with national and/or state pyramid (national age distribution is included in the text)
- age characteristics of mine workers and families (the change in age distribution in a boom community is included for reference in the text)

[redacted]

Findings:
___ very similar ___
___ similar ___
___ not similar ___

Points

Comments: ___ ___

D. Sex Ratio

Norm: 51% female, 49% male (for the United States)
County ___
Miners ___

Points

Comments: ___ ___

Total Points for Part 1: ___

Worksheet for Part 2: Social Services

A. Schools

1. a. Current number of students ___
   b. Current number of teachers ___
   c. Current number of classrooms used or available ___
   d. Projected enrollment without additional students (obtain from local school district) ___
   e. Projected enrollment with additional students (number of new students as a result of the mine = ½ the number of new workers, both direct and induced) ___

2. Determine the capacity of schools (using numbers in part 1)

a. a ÷ 25 = number of classrooms presently used = ________

b. e - a = total number of new students = ____________

c. $\frac{\text{total number of new students}}{25}$ = $\frac{\_\_\_\_\_\_\_\_}{25}$ = ________ (the number of additional classrooms needed)

(average number of students per classroom)

d. Add the number of classrooms presently used to the number of additional classrooms needed. Subtract from this the current number of classrooms available (1.c). A negative number implies inadequate space; a positive number means that space is adequate.

B. Hospitals/Doctors

	community/county	state/nation
Number of doctors/population	________	________
Number of dentists/population	________	________
Number of beds in hospital/ population	________	________

Points ________

C. Government Structure

Number of staff ________
Mayor (yes/no) ________
Planners (yes/no) ________
Engineer (yes/no) ________

Points ________

D. Water/Sewage

1. Water

Average daily water use ____________
Total available water ____________
- Remaining capacity ____________

(water used/person)__________ x (present + additional population)

________ = (total water needed)________________.

(total water capacity)____________ - (total water needed)________

= (additional water needed)______________. (positive = adequate; negative = additional capacity necessary)

2. Sewage

Average number of gpd (gallons per day) generated per person:

____

Capacity of treatment facility ____________

gpd/person ________ x (present and additional population) ________

= (total capacity needed) __________.

(capacity of the facility) ________ - (total capacity needed)

____________ = _____________. (positive = adequate; negative = additional capacity necessary)

Total Points for Part 2 ________

Worksheet for Part 3: Present Economic Structure

A. Employment Distribution

Major employers	Number of employees	% of Total
- Agriculture		
- Mining		
- Retail		
- Education		
- Government		
- Services		
Mine Employment		
- Direct		
- Indirect		

Points ________

B. Occupational Distribution

(Determined by using information in Part A. An area with an even distribution of employment would be one in which no particular employer dominates, such as agriculture or construction. The points should be based on the distribution of employment within the town.

Points ________

C. Unemployment

	Rate	Number
Nearest community	____%	
Communities within 25 miles		
____________________	____%	
____________________	____%	
____________________	____%	

Number of jobs to be created ________
(refer to employment distribution)

(number of jobs to be created) / (number of unemployed) = ________ / ________ = (ratio) ________

Points ________

D. Income (Payroll)

Total community income $__________

Total mine income $2,400,000 % of total ____%
(for a 1 mtpy mine)

Points ________

Comments: ____________________

Total Points for Part 3 ________

Worksheet for Part 4: Bonding Capacity

Maximum remaining capacity ________

Extent of the requirement for new capital:

- New schoolrooms (yes/no) ______
- Expand water treatment (yes/no) ______
- Expand sewer system (yes/no) ______

Total Points for Part 4 ________

Worksheet for Part 5: Private Economic Activity

Size of nearby communities (50-mile radius)

Name	Population

Comments: ____________________

Total Points for Part 5 ________

Worksheet for Part 6: Housing

1. Vacancy rate ________
2. Type of housing
    - single family ________
    - multifamily ________
    - mobile homes ________
3. Number of vacant units ________
4. Direct and induced employment (1 mine) ________

Employed (4) - number of vacant units (3) = ________ (indication housing need)

Comments: ____

____

____

Total Points for Part 6 ________

SOCIOECONOMIC RATING FOR THE COAL LEASE TRACTS

Tract	Rating
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

VII LEGAL/INSTITUTIONAL IMPACT INDICATOR

A. Introduction

The many diverse political constituencies that are represented in the laws and that affect coal development and protection of the environment influence legal and institutional impacts on coal mining. Conflicts arise because land that is rich with coal also supports agriculture, ranching, forestry, wildlife, and recreation, and because policies that require clean air and water to ensure public health -- and land use -- conflict with a policy of maximum development of domestic energy resources. The resulting compromises, which are necessary to satisfy constituencies and interests at odds with one another, create complex problems for those charged with leasing the public's coal resources. This study has developed legal impact indicators that account for the variety of land uses for areas overlying federal coal.

The fragmented ownership of surface and mineral rights is a second important indicator that can be used in choosing which coal tracts to lease. Large amounts of western coal (i.e., the mineral "estate," or mineral rights under the ground) are owned by the federal government, Indian tribes, state governments, and railroads. The rights to the ground surface that lies over that coal may or may not be owned by the entity that owns the mineral rights. For example, in Montana and Wyoming, the federal government owns about three-fourths of the coal, whereas much of the surface is privately owned. Federal homestead programs allowed individuals to stake out and settle western lands for homes, farming, or stock raising. The homesteader obtained title to the surface land, but the federal government reserved the mineral rights for itself.

A related indicator results from the "checkerboard" ownership pattern in the West of land alongside grants made to the railroads. One hundred years ago, the federal government granted these railroads every other section (640 acres) along the projected right of way, with the swath of land granted to the railroads ranging in width from 12 to 200 miles. As a result, the railroads own an estimated 22 billion "checkerboarded" tons of coal, or about 11 percent of the demonstrated coal reserves in the seven western states (Carlson, 1978). Congress also made land grants to the states in conjunction with early railroad development, and gave to the states the sixteenth and thirty-sixth sections of every township for educational purposes. These congressional disbursements resulted in a startling pattern of ownership of land and resources. These fragmented and confused ownership patterns make the straightforward, environmentally responsible leasing of a given coal deposit quite difficult. The difficulty is compounded in attempting to respect the interests of known surface owners, agricultural renters, grazing permittees, and "lost" or unknown surface owners.

Appendix A summarizes the legal framework in which leasing of federal coal takes place, and includes a discussion on state and local laws. Note that the legal complexities surrounding a tract of land do not, in and of themselves, indicate whether that tract should be leased instead of another. Each piece of legislation in the regulatory framework that deals with public land or the mining of federal coal ostensibly has a benevolent goal -- be it planning, environmental protection, quality of life, occupational safety, preservation of species, memorializing of historical or archeological places of interest, or other worthwhile purposes. Therefore, it is inappropriate to choose to lease a given tract simply because it has a shorter list of legal requirements. The tract with the longer list of requirements could prove to be the better choice because needed considerations are codified.

An illustrative point of policy is raised in the case of differential state taxation. If, for instance, two equally attractive areas in the Powder River Basin were being considered for leasing by the federal government, the only difference between them might be that one tract lies in Montana and the other in Wyoming. Is it appropriate for the federal leasing officer to consider that Montana's 30% severance tax (much stricter than the overall 10.5% tax in Wyoming) might impede diligent mining of the Montana tract? Should the leasing officer consider the state's purposes in having such a tax or how the revenues from that tax are spent in the state? As can be seen, assigning a positive or negative value to good faith state legislation is difficult.

Overlaying the legal methodology would be the leasing policy of the Department of the Interior (DOI). In October 1977, DOI announced that it would not issue leases for coal mining when the surface is privately owned unless the surface is already owned by a coal company. This policy must also be considered in applying the methodology.

To reiterate, two key legal indicators have been selected for analysis: "land use" and "ownership." Other legal impacts that would affect coal mining are reflected in the sections on the hydrology, water quality, and biological impact indicators. For the land use indicator the best score possible, one that represents minimal conflict, would be 50. Similarly, the best score possible for the ownership indicator would be 50. The scores for a given tract for these two indicators are added to obtain an overall legal/institutional rating for that tract; this process should be repeated for each tract. These ratings are then compared across all tracts considered to judge their relative attractiveness from a legal/institutional standpoint (see Figure VII-1). Worksheets are provided at the end of the chapter.

B. Methodology

1. Alternative Land Use Element

The characteristics of a tract of land can give it multiple uses in addition to being an economic coal resource. Many of these uses have been given statutory recognition and protection. Thus, in considering two tracts of land, it must be determined which tract has more uses or unique uses and characteristics that might have to be foregone because of coal development. For this indicator, the tract with the least valuable uses would be the tract favored for leasing. It is

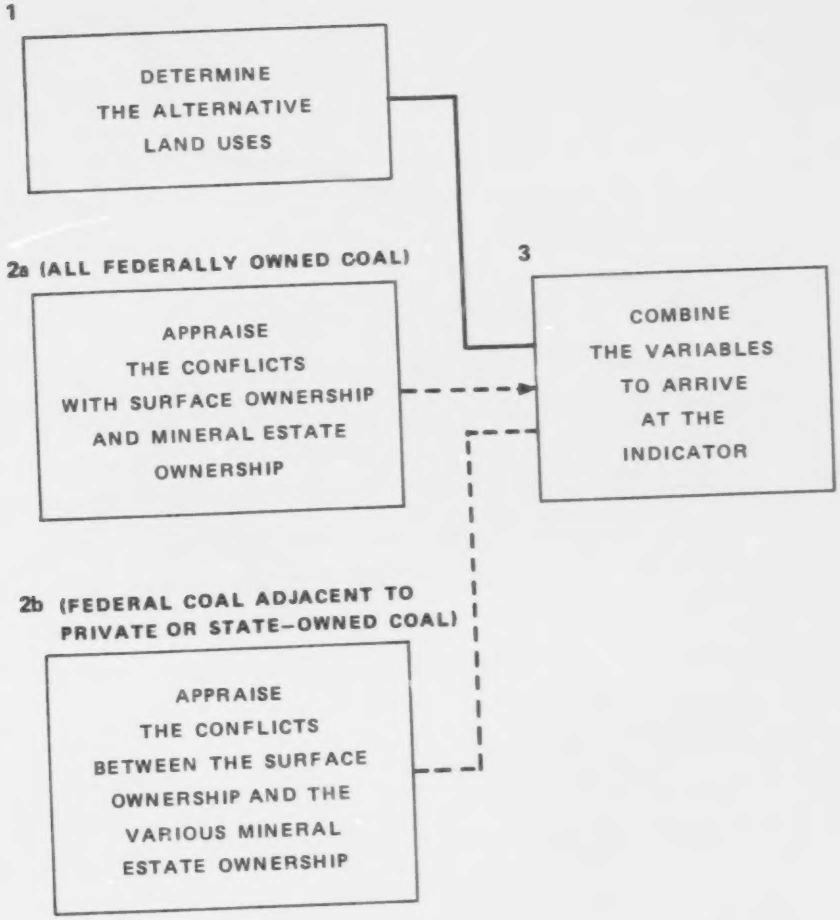
1
DETERMINE THE ALTERNATIVE LAND USES
2a (ALL FEDERALLY OWNED COAL)
APPRAISE THE CONFLICTS WITH SURFACE OWNERSHIP AND MINERAL ESTATE OWNERSHIP
2b (FEDERAL COAL ADJACENT TO PRIVATE OR STATE-OWNED COAL)
APPRAISE THE CONFLICTS BETWEEN THE SURFACE OWNERSHIP AND THE VARIOUS MINERAL ESTATE OWNERSHIP
3
COMBINE THE VARIABLES TO ARRIVE AT THE INDICATOR

FIGURE VII-1. APPRAISAL STEPS FOR THE LEGAL/INSTITUTIONAL IMPACT INDICATOR

important to note whether the tracts are adjacent to or near land use activities that would be disrupted by coal mining.

The user must first ascertain current land use (e.g., agriculture, ranching, forestry, wilderness protection, or recreation) and then determine the archaeological or historical value of the land. A determination of the impact of coal leasing entails finding out what the current land use is and what likely future will be.

The methodology now weights various land uses equally because of the great difficulty in comparing, for example, food raising with wilderness protection. When the methodology is applied, differential weighting may prove appropriate. For example, if a world food shortage should occur, a weighting favoring agricultural use might be justified. Changing the weights is left to the user of the methodology.

Table VII-1 is the key to assigning a land use score to a given tract. In each column, a judgment is made about the level and type of use, and that column's score is multiplied by the assigned weight at the bottom of the column. For example, if the land is scrub land and has little potential for agriculture, that column would get 50 points (minimum conflict), multiplied by the assigned weight of 0.20, giving a net column score of 10. Moving on to the ranching column, if the scrub land is being used for marginal grazing, that column would get 20 points (moderate conflict) multiplied by the assigned weight of 0.20, giving a net column score of 4. The remaining three columns should receive similar treatment. The net column scores for the five columns are then added together to obtain a total score for the alternative land use indicator for a tract.

2. Conflicts Associated with Surface Ownership and Mineral Estate Ownership

a. Federal Ownership of the Coal (Mineral Estate) (Step 1) -- When the federal government owns the coal, analysis should focus on the nature of the ground (surface estate) above the federal coal;

Table VII-1

ALTERNATIVE LAND USE ELEMENT AND POTENTIAL VALUES AND WEIGHTS TO BE ASSIGNED

Alternative Use, Value	Agriculture	Ranching	Forestry	Wilderness Protection/ Recreation	Archaeological Historical Importance
Minimal conflict, 50	Land not attractive for agricultural use or agricultural activity merely adjacent	Land not attractive for grazing or grazing activity merely adjacent	Unforested land	Land not designated as wilderness protection or recreation area	No archaeological or historical importance
Moderate conflict, 20	Agricultural use marginal	Ranching use marginal	Land forested but not a part of U.S. forest system	Land adjacent to wilderness protection area or recreation area	Cultural value but not officially designated by state or federal officials
Major Conflict, 10	Prime agricultural land producing crops	Good grazing land used for raising livestock	Land part of U.S. forest system	Land designated as wilderness protection or recreation area	Land officially recognized as important archaeologically or historically
Assigned Weight	0.20	0.20	0.20	0.20	0.20

Table VII-2 is used to develop this indicator. The Surface Mining Control and Reclamation Act of 1977 makes provision for protecting surface owners of lands over federal coal and the holders of surface leases on federal lands over federal coal. The Secretary of the Interior is prohibited from leasing federal coal until surface owners have given written consent for surface mining to begin. For purposes of coal lease planning, the Secretary is to consult with surface owners within a tract that is being considered for leasing; at his discretion, he can refrain from leasing federal coal for surface mining when "a significant number of surface owners have stated a preference against the offering of the deposits for lease. . . ." Written consent must be obtained from surface lessees or permittees, or a bond must be executed to secure payment to them if their surface interest is harmed.

It is necessary to ascertain whether a surface lease exists, and if so whether permission has been obtained to disturb the surface. Then ascertain whether the surface is privately owned, and if so whether permission has been obtained. This information will indicate whether a conflict exists between the surface estate and the federal coal estate.

The impact would be greatest where the ownership or lease is held by a party whose permission to disturb the surface has not been obtained. Areas in which a minimum of conflict would occur are those where permission has been obtained or that are owned and controlled by the federal government, with no outstanding federal surface leases or permits.

To use Table VII-2, first look at column one. If the federally owned surface over the federally owned coal is under lease to a private party who has given permission for strip mining to take place, a score of 20 points would result. This score is then multiplied by the weight at the bottom of the column. For example, 0.6, will give a net score for the column of 12. In column two, if the corporation that owns the

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*It is probable that a price would be negotiated for such permission.

Table VII-2

SURFACE AND MINERAL ESTATE OWNERSHIP

Alternative Use, Value	Federal Surface Ownership/ Federal Coal Ownership	Private Surface Ownership/ Federal Coal Ownership
Minimal conflict, 50	No outstanding surface leases or permits	Surface estate owned by potential coal lessee
Moderate conflict, 20	Surface leases or permits in effect and permission obtained from lessee/ permittee (or bond executed)	Permission obtained by Secretary of the Interior from owners of surface estates
Major conflict, 10	Surface leases or permits in effect but permission not obtained (nor bond executed)	Permission not obtained from surface owners
Assigned Weight	F[a]	1.0 - F

---

[a] Assigned weight F = decimal fraction of tract that has federal surface ownership and federal coal ownership.

surface over the federally owned coal has agreed to allow the surface to be disturbed,* the score will be 20 points. This score is multiplied by the weight at the bottom of the column, in this example 0.4, giving a net score for the column of 8. The total score for the ownership indicator for this particular tract would be the sum of the two columns, or 20 points.

b. Federal Coal Adjacent to Privately or State-owned Coal (Step 2) -- When federal coal and nonfederal coal must be mined together for an efficient, economic "logical mining unit," the position of the federal government is uncertain because DOI has no real control or influence over a private coal owner's decision to lease his mineral rights.*

For development of an indicator when private or state coal lies next to federal coal, Table VII-3 is the appropriate reference.

The user must determine whether surface rights to the private coal are owned by an individual (or corporation) different from the owner of the mineral rights, whether the federal coal lease applicant owns or has a lease for the adjoining nonfederal coal, and the percent of the proposed lease tract that is privately owned. The extent of the conflict between the surface estate and the mineral estate for the privately owned coal must be determined, as must the relationship between the privately owned coal and the federally owned coal (relative areas, relationship of the would-be lessee of the federal coal to ownership or leasehold of private coal, and so on).

---

*In this respect, state ownership of a coal resource or of the surface estate resembles private ownership. That is, the federal government has no direct control or influence over a state's decision to lease its coal. However, states are generally interested in responsible coal development on a "logical mining unit" basis. This concern would probably make them more responsive to federal desires for development than would be private owners, who may be more interested in retaining their coal resources for speculation.

The greatest conflict occurs when surface owners (above the federal coal and/or above the private coal) have not given permission to disturb the surface. The least conflict occurs when permission has been obtained to disturb the federal and private surfaces and when there are no outstanding federal surface permits. To distribute the points, consult Table VII-3.

The first two columns, with federal coal ownership, are treated like those in Table VII-2. Column 3 adds the dimension of private (or state) coal ownership to the analysis.

As an example of how to use Table VII-3, assume that for 60% of the tract the federal government owns both the surface and the coal (hence $F_1 = 0.6$), and that no surface leases or permits are outstanding. The score for column 1 would be 50 (minimum conflict) multiplied by the weighting ($F_1 = 0.6$), for a net column score of 30. If 30% of the tract has private surface ownership combined with federal coal ownership ($F_2 = 0.3$), and if permission has been obtained from the owners of the surface estates, the score for the column would be 20 multiplied by the weighting ($F = 0.3$), for a net column score of 6. The remainder of the tract would be in the category of private surface ownership/private coal ownership ($F_3 = 0.1$).* If the private coal and private surface estate are not owned by the same individual or corporation that owns the private surface, but the parties are amenable to coal development, the column would receive a score of 20 points multiplied by the weighting factor ($F_3 = 0.1$) for a net column score of 2. The total score for the ownership indicator for this particular tract would be the sum of the three columns, or 30 + 6 + 2 = 38.

c. Total Points (Step 3)

Scores for the two key indicators, "alternative land use" and "ownership," are then added to yield the overall legal/institutional rating. The tract with the highest score would be the most attractive for leasing.

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*$F_1 + F_2 + F_3 = 1.0$.

To predict the legal/institutional difficulties that might accompany the leasing of a tract, an analyst's judgment may be required. Using a legal analyst would also ensure that the environment and socioeconomic analyses, which are critical parts of the methodology, meet the federal, state, and local legal requirements.

Note that environmental considerations are the subject of federal and state law. For this study, environmental indicators for air and water quality are dealt with generically in the environmental section of the report. Similarly, the Endangered Species Act is treated in the environmental section.

Table VII-3

CHECKERBOARD LAND AND MINERAL OWNERSHIP POTENTIAL VALUES AND WEIGHTS TO BE ASSIGNED

Alternative Use, Value	Federal Surface Ownership/ Federal Coal Ownership	Private Surface Ownership/ Federal Coal Ownership	Private Surface Ownership/ Private Coal Ownership
Minimal conflict, 50	No outstanding surface leases or permits	Surface estate owned by potential coal lessee	Coal and surface privately owned by same individual or corporation, willing to lease the coal
Moderate conflict, 20	Surface leases or permits in effect and permission obtained from lessee/ permittee (or bond executed)	Permission obtained by Secretary of the Interior from owners of surface estates	Coal and surface not owned by the same individual, or corporation, but parties are amenable to coal development
Major conflict, 10	Surface leases or permits in effect but permission not obtained (nor bond executed)	Permission not obtained from surface owners	Adjoining private coal and adjoining private surface estate not owned by the same individual or corporation, and permission not obtained to mine the coal
Assigned Weight [a]	F_1	F_2	F_3

---

[a] Decimal fraction F of tract area = $F_1 + F_2 + F_3 = 1.0$.

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract ___

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture			
Ranching			
Forestry			
Wilderness Protection/			
Recreation			
Archaeological/			
Historical Importance			

Alternative Land Use Score ___

WORKSHEET FOR OWNERSHIP ELEMENT

Tract ___

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	________ ________ ________ ________	____	x	____	=	____
Private[a] Surface Ownership/ Federal Coal Ownership	________ ________ ________ ________	____	x	____	=	____
Private[a] Surface Ownership/ Private Coal Ownership[b]	________ ________ ________ ________	____	x	____	=	____

Ownership Element Score ____

---

[a] Includes state-owned land.

[b] Includes state-owned coal.

ALTERNATIVE LAND USE ELEMENT SUMMARY SHEET

Tract	Score
1	______
2	______
3	______
4	______
5	______
6	______
7	______
8	______
9	______
10	______

SURFACE-OWNERSHIP/MINERAL-OWNERSHIP ELEMENT SUMMARY SHEET

Tract	Score
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

SUMMARY OF LEGAL/INSTITUTIONAL IMPACT INDICATOR

Tract	Alternative Use Element	Ownership Element	Overall Score	Ranking
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

VIII FINAL WEIGHTING

The various indicators must be combined to obtain an overall rating for a particular lease tract. Once that is accomplished, a comparison of the selected areas can be made. A method that could be called "comparative value perspectives," has been chosen because it illustrates differing interpretations and weighting of the same data. The rankings depend on which group is applying the methodology. In some instances the proposed coal lease areas could be ranked differently, and in others they could receive approximately the same ranking, but with emphasis on different concerns.

The purpose of this method of summation is not only to apply weightings as the SRI team that developed the methodology would apply them, but also to provide EPA with insight into the way other potential stakeholders or interest groups would view the proposed coal lease areas. By understanding the factors that are considered to be of most importance to others, EPA can be prepared for controversies that will arise as a result of the varying viewpoints.

One of the important characteristics of this system is the groups that are chosen to be represented: environmental activists, mining companies, local governments, local citizens, and the cognizant federal agencies. Each can be expected to have a different weighting of the impact indicators: coal resource economics, hydrology/water quality, air quality, biology, socioeconomic, impact and legal/institutional conflict. The weightings reflect the relative priority, or importance, that the various groups attach to the indicators. All of the weightings are considered to relfect reasonably the "average" values of members of the groups represented. Our hypothetical weightings for each group are described below. To obtain each interest group's preference ranking for coal tract leasing, one-by-one, each group's set of indicator weightings is multiplied by the raw indicator scores for the various tracts obtained in earlier stages of the methodology. Sample worksheets are included at the end of the chapter.

A. Environmental Groups

Environmental activists tend to focus on preserving the natural environment. When the natural environment is either being sufficiently protected or is not considered to be "significant," environmentalists tend to focus on the "human environment." Very little of their energy is usually focused on the economic and legal/institutional considerations included in the indicators unless a national park, wilderness area, or wild river would be affected. Therefore, the impacts on the ecological areas are given the greatest weighting, followed by effects on the air and water quality. The impacts on the social environment are considered of next importance. Very little emphasis is given to the legal/institutional and the economic indicators.

B. Mining Companies

The interest of mining companies are assumed to be almost the reverse of those of the environmental groups. Economics -- making a profit -- is their main driving force. The companies consider two major factors when determining the economics of mining an area: the economics of production and the legal/institutional constraints (because various requirements must be satisfied before production can begin). Mining companies also have a concern for the local socioeconomic environment insofar as it affects their employees. If the local social environment is unsatisfactory -- for example in the housing, retail, and entertainment areas -- it will have a detrimental effect on their employees and their performance on the job. The physical environment, including air and water quality, is typically not of paramount concern to the companies, unless it affects their ability to mine an area economically and safely.

C. Local Government

The major concern of local government officials is the welfare of the community -- both of the people and of the infrastructure. The officials generally want to ensure that the town benefits from the coal mining. Their responsibility includes the legal/institutional factors, seeing that valuable land is not irreparably damaged, or in some cases, such as parks and reserve areas, that they are not marred by the mining. Water quality is another major concern, particularly in the West, because supplies are limited, and, in some areas, very scarce.

D. Local Citizens

The local people are mostly concerned about how the mining is going to affect them personally. They are worried about the effects of the newcomer in their community (housing shortages, increase in prices, increase in crime). Therefore, a great deal of weight is given to the socioeconomic impacts by the "old timers." Along the same vein, the local residents are often very concerned about not only their water supply (aquifer destruction) but also the quality of the water (increase in sediment). If the socioeconomic climate is such that it can accommodate the impacts, the people's attention then turns to ecology and the possible harm to the environment. Finally, the people are somewhat concerned about the legal/institutional aspects and the economics of the mining, but again, only as they affect their lives.

E. Cognizant Federal Agencies/SRI Study Team

The SRI study team has developed its own weighting factors based on past studies of the effects of coal mining on the indicator areas. It is likely that the cognizant government agencies, possessing a bureaucratic, expert, technocratic, uninvolved, stake in the leasing might adopt a a weighting profile similar to that of the SRI study team. In formalizing our weighted profile, one important assumption concerned the potential reversal of the impacts. The study team determined, through analysis of other impacts and reports, that while socioeconomic impacts are highly significant, a combination of planning and funds (both from the government and private sources) can lessen, if not eliminate, many of the detrimental effects. Accordingly, greater significance was given to the ecological and hydrological impacts that could cause irreparable damage, such as the destruction of an aquifer or the loss of a wildlife species, either from the destruction of its environment or the killing of the species. Legal/institutional issues are viewed by the study team in much the same manner as the socioeconomic impacts. They can be resolved through negotiation, and therefore they are not given as much weight as the impacts on the ecosystems and the hydrology. The SRI study team weighted the impacts assuming that all of the tools (e.g., federal funds) and past experience will be put to use. So even though the team considers all categories of the impacts as equally significant, indicators are given more weight if the impacts they measure cannot be controlled or are not repairable at this time.

Table VIII-1 lists the weighting given by the various interest groups to the six indicators. These weightings were used in our test case (see Appendix A).

Table VIII-1

WEIGHTING FACTORS

Area of Concern	Environmental Groups	Mining Companies	Local Governments	Local People	SRI Study Team
Biology	0.40	0.00	0.05	0.10	0.35
Hydrology/Water Quality	0.25	0.00	0.20	0.20	0.25
Air Quality	0.15	0.00	0.08	0.10	0.10
Socioeconomic	0.10	0.05	0.40	0.50	0.15
Economic	0.03	0.80	0.07	0.05	0.10
Legal	0.07	0.15	0.20	0.05	0.05
Total	1.00	1.00	1.00	1.00	1.00

FINAL RANKINGS WORKSHEET

Ranking	Environmentalists		Mining Companies		Local Government		Local Citizens		SRI Study Team	
	Tract Number	Weighted Score[a]	Tract Number	Weighted Score[a]	Tract Number	Weighted Score[a]	Tract Number	Weighted Score[a]	Tract Number	Weighted Score[a]
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

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[a] Scores rounded to two significant figures.

COMPARATIVE VALUE PERSPECTIVES RANKING WORKSHEET

Indicator	Unweighted Raw Score	Weighted Score				
		Environmentalists	Mining Companies	Local Government	Local Citizens	SRI Study Team
Tract 1						
Coal Resource Economics						
Hydrology/Water Quality						
Air Quality						
Biology						
Socioeconomic						
Legal/Institutional						
Total						
Tract 2						
Coal Resource Economics						
Hydrology/Water Quality						
Air Quality						
Biology						
Socioeconomic						
Legal/Institutional						
Total						
Tract 3						
Coal Resource Economics						
Hydrology/Water Quality						
Air Quality						
Biology						
Socioeconomic						
Legal/Institutional						
Total						
Tract 4						
Coal Resource Economics						
Hydrology/Water Quality						
Air Quality						
Biology						
Socioeconomic						
Legal/Institutional						
Total						

COMPARATIVE VALUE PERSPECTIVES RANKING WORKSHEET (Continued)

Indicator	Unweighted Raw Score	Weighted Score Environmentalists	Mining Companies	Local Government	Local Citizens	SRI Study Team
Tract 5						
Coal Resource Economics	____	____	____	____	____	____
Hydrology/Water Quality	____	____	____	____	____	____
Air Quality	____	____	____	____	____	____
Biology	____	____	____	____	____	____
Socioeconomic	____	____	____	____	____	____
Legal/Institutional	____	____	____	____	____	____
Total	____	____	____	____	____	____
Tract 6						
Coal Resource Economics	____	____	____	____	____	____
Hydrology/Water Quality	____	____	____	____	____	____
Air Quality	____	____	____	____	____	____
Biology	____	____	____	____	____	____
Socioeconomic	____	____	____	____	____	____
Legal/Institutional	____	____	____	____	____	____
Total	____	____	____	____	____	____
Tract 7						
Coal Resource Economics	____	____	____	____	____	____
Hydrology/Water Quality	____	____	____	____	____	____
Air Quality	____	____	____	____	____	____
Biology	____	____	____	____	____	____
Socioeconomic	____	____	____	____	____	____
Legal/Institutional	____	____	____	____	____	____
Total	____	____	____	____	____	____
Tract 8						
Coal Resource Economics	____	____	____	____	____	____
Hydrology/Water Quality	____	____	____	____	____	____
Air Quality	____	____	____	____	____	____
Biology	____	____	____	____	____	____
Socioeconomic	____	____	____	____	____	____
Legal/Institutional	____	____	____	____	____	____
Total	____	____	____	____	____	____

COMPARATIVE VALUE PERSPECTIVES RANKING WORKSHEET (Concluded)

Indicator	Unweighted Raw Score	Weighted Score Environmentalists	Mining Companies	Local Government	Local Citizens	SRI Study Team
Tract 9						
Coal Resource Economics	____	____	____	____	____	____
Hydrology/Water Quality	____	____	____	____	____	____
Air Quality	____	____	____	____	____	____
Biology	____	____	____	____	____	____
Socioeconomic	____	____	____	____	____	____
Legal/Institutional	____	____	____	____	____	____
Total	____	____	____	____	____	____
Tract 10						
Coal Resource Economics	____	____	____	____	____	____
Hydrology/Water Quality	____	____	____	____	____	____
Air Quality	____	____	____	____	____	____
Biology	____	____	____	____	____	____
Socioeconomic	____	____	____	____	____	____
Legal/Institutional	____	____	____	____	____	____
Total	____	____	____	____	____	____
Tract 11						
Coal Resource Economics	____	____	____	____	____	____
Hydrology/Water Quality	____	____	____	____	____	____
Air Quality	____	____	____	____	____	____
Biology	____	____	____	____	____	____
Socioeconomic	____	____	____	____	____	____
Legal/Institutional	____	____	____	____	____	____
Total	____	____	____	____	____	____
Tract 12						
Coal Resource Economics	____	____	____	____	____	____
Hydrology/Water Quality	____	____	____	____	____	____
Air Quality	____	____	____	____	____	____
Biology	____	____	____	____	____	____
Socioeconomic	____	____	____	____	____	____
Legal/Institutional	____	____	____	____	____	____
Total	____	____	____	____	____	____

Appendix A

METHODOLOGY TEST CASE

I. Introduction

Northwest Colorado (specifically Moffet, Rio Blanco, and Routt Counties) was chosen as the area for testing our methodology (see Figure A-1). Located within this region are two known recoverable coal resource areas (KRCRA), Yampa and Danforth Hills. KRCRAs were developed by the U.S. Geologic Survey and have been designated as areas in which there is high potential of coal availability. The twelve areas the SRI team choose as potential "lease tracts" are located within the Danforth and Yampa KRCRA (See Figures A-2 and A-3).

Each of the indicators was applied to the test site, using the step by step methodology described in the handbook. The purpose of testing the methodology was twofold: one, to ensure that there were no gaps or impossible steps in the original design; and two, to make sure that the methodology was as simple as possible while still providing a sufficient amount of information to rank potential coal lease areas.

Once the indicators had been applied to all the sites (See Table A-1*), a final ranking was obtained by using the comparative value perspectives technique. The final weighting process resulted in some very interesting conclusions (see Table A-1 and Figure A-4). Many times, the different groups could be expected to come up with the same overall ranking, but for different reasons (see Table A-2). The different ranking given by the various groups is graphically illustrated in Figures A-5 through A-16.

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*In these tables the calculations are displayed exactly as they were performed. The number of figures displayed for each entry is more than are significant.

The "local citizens" and the "local governments" were in closest agreement, as would be expected. There was very little difference in the ranking. Environmentalists and mining companies were in agreement on the ranking of three tracts, which is surprising since their areas of concern as depicted in the comparative value perspective are almost opposite.

It is important to note that there never was full agreement on the leasing order. Two groups would in some cases agree on the order of a particular tract. In general, however, rankings of each group were unique.

This final weighting method provides insight into possible problem areas which could be avoided with proper planning and foresight. For example, the environmental groups and the miners could give a potential coal lease tract a very similar rating, but if you examine the graphs that illustrate all the components, there are very few similarities in what went into the final weighting (see Figures A-5 through A-16).

Each of the indicators has been worked out on worksheets, identical to those provided in the handbook. Also, brief analyses are included to explain the results from the test case. To understand the results it may be necessary to go back and read the section in the handbook dealing with the particular worksheet.

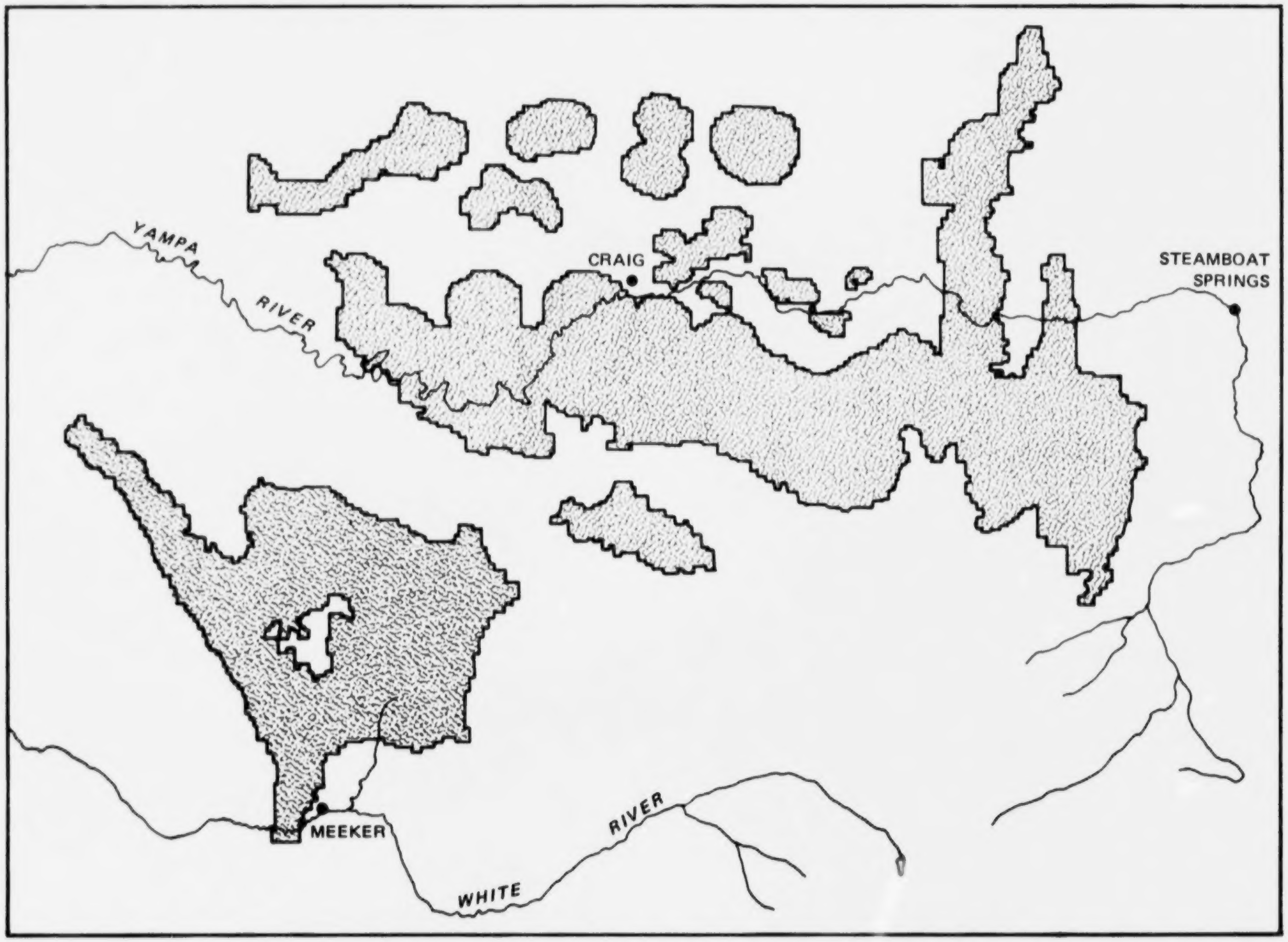
YAMPA
RIVER
CRAIG
STEAMBOAT SPRINGS
MEEKER
WHITE
RIVER

FIGURE A-1. MAP OF NORTHWEST COLORADO INCLUDING THE LOCATION OF YAMPA AND DANFORTH HILLS KRCRA

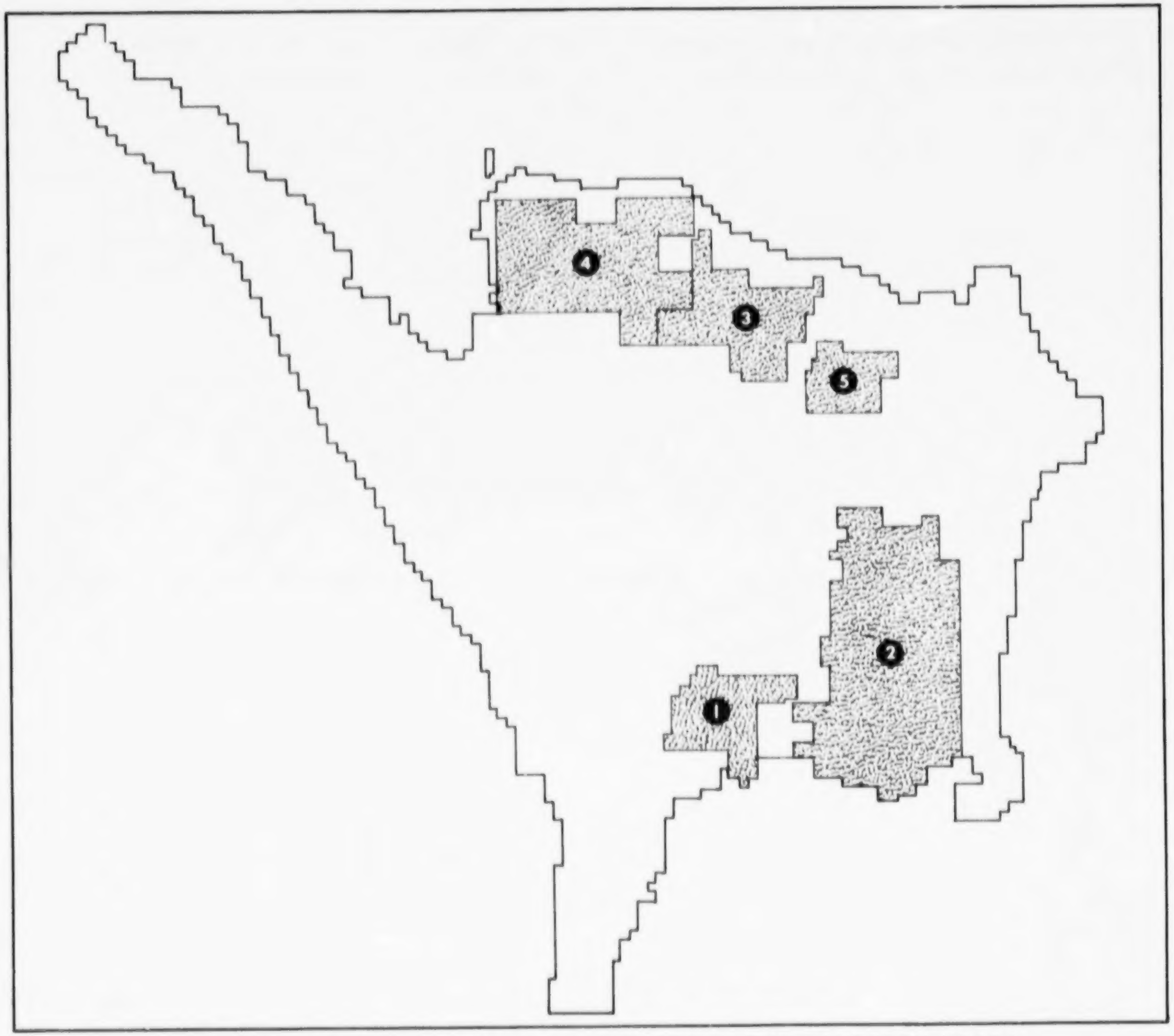

FIGURE A-2. LEASE TRACTS 1–5 LOCATED IN THE DANFORTH KRCRA

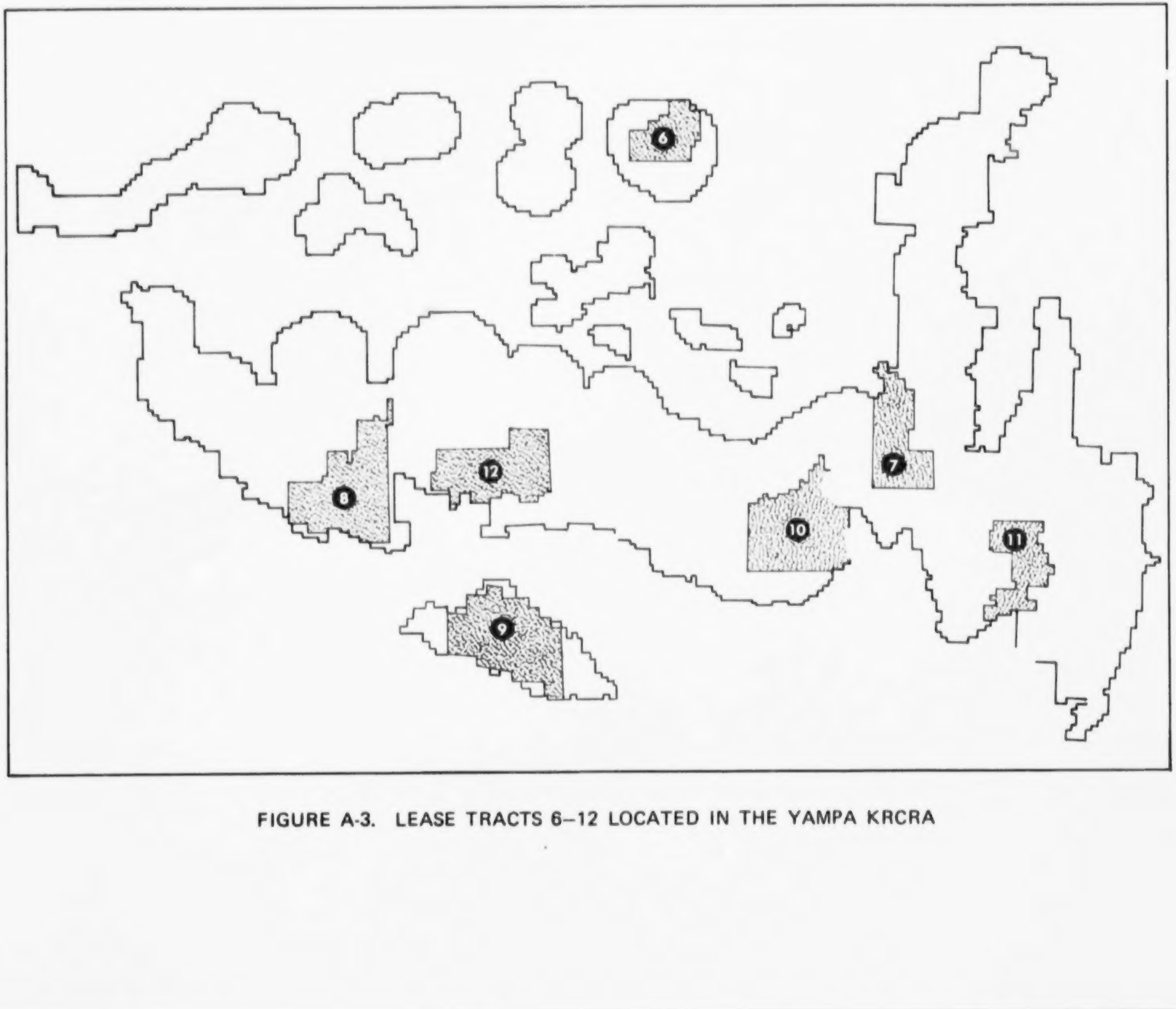
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FIGURE A-3. LEASE TRACTS 6–12 LOCATED IN THE YAMPA KRCRA

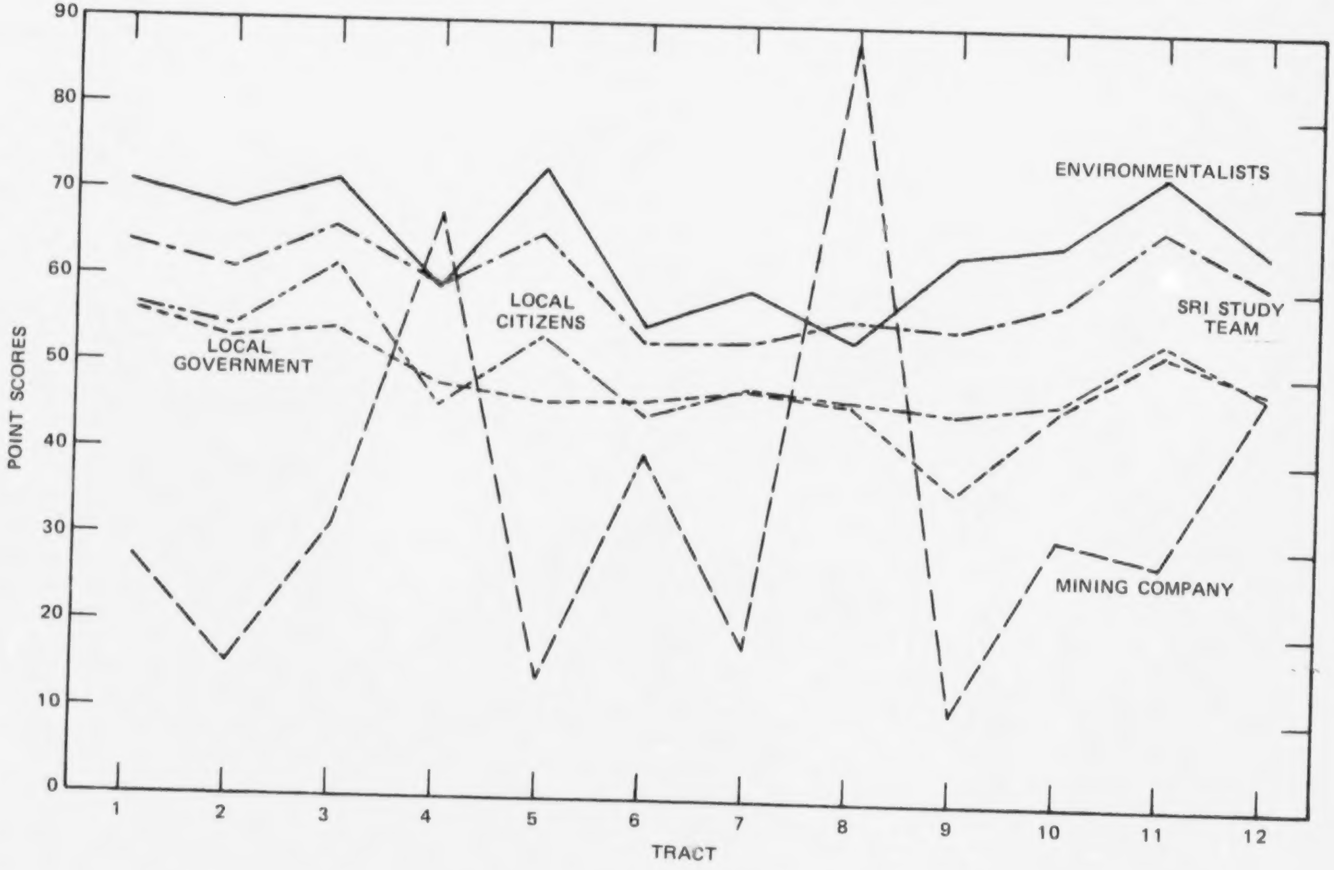

FIGURE A-4. RANKING OF THE TWELVE COAL LEASE SITES BY THE VARIOUS GROUPS

Table A-1

FINAL RANKINGS

Ranking	Environmentalists		Mining Companies		Local Government		Local Citizens		SRI Study Team	
	Tract Number	Weighted [a] Score	Tract Number	Weighted[a] Score	Tract Number	Weighted[a] Score	Tract Number	Weighted[a] Score	Tract Number	Weighted[a] Score
1	11	73	8	88	1	56	3	62	3	66
2	5	73	4	68	3	54	1	57	5	65
3	3	72	12	47	2	53	2	54	11	64
4	1	71	6	40	11	53	11	54	1	64
5	2	68	3	31	12	48	5	53	2	61
6	10	64	10	31	4	48	7	48	12	60
7	12	64	11	28	7	48	12	48	4	59
8	9	63	1	28	5	46	10	47	10	58
9	7	59	7	18	6	46	8	47	8	56
10	4	59	2	15	8	46	4	46	9	55
11	8	56	5	14	10	44	9	45	7	53
12	6	55	9	11	9	37	6	45	6	53

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[a] Scores rounded to two significant figures.

Table A-2

COMPARATIVE VALUE PERSPECTIVES RANKING

Indicator	Unweighted Raw Score	Weighted Score				
		Environmentalists	Mining Companies	Local Government	Local Citizens	SRI Study Team
Tract 1						
Coal Resource Economics	2	0.06	16.00	0.10	0.10	0.20
Hydrology/Water Quality	70	17.50	0.00	14.00	14.00	17.50
Air Quality	94	14.10	0.00	7.52	9.40	9.40
Biology	77	30.80	0.00	3.85	7.70	26.95
Socioeconomic	45	4.50	2.25	18.00	22.50	6.75
Legal/Institutional	62	4.34	9.30	12.40	3.10	3.10
Total	349	71.30	27.55	55.87	56.80	63.90
Tract 2						
Coal Resource Economics	5	0.15	4.00	0.25	0.25	0.50
Hydrology/Water Quality	57	14.25	0.00	11.40	11.40	14.25
Air Quality	94	14.10	0.00	7.52	9.40	9.40
Biology	77	30.80	0.00	3.85	7.70	26.90
Socioeconomic	45	4.50	2.25	18.00	22.50	6.75
Legal/Institutional	61	4.27	9.15	12.20	3.05	3.05
Total	339	68.07	15.40	53.22	54.30	60.85
Tract 3						
Coal Resource Economics	23	0.69	22.40	1.15	3.45	2.30
Hydrology/Water Quality	82	20.50	0.00	16.40	16.40	20.50
Air Quality	94	14.10	0.00	7.52	9.40	9.40
Biology	69	27.60	0.00	3.45	6.90	24.15
Socioeconomic	45	4.50	2.25	18.00	22.50	6.75
Legal/Institutional	60	4.20	6.75	9.00	3.00	3.00
Total	373	71.59	31.40	55.52	61.60	66.10
Tract 4						
Coal Resource Economics	70	2.10	56.00	3.50	3.50	7.00
Hydrology/Water Quality	61	15.25	0.00	12.20	12.20	15.25
Air Quality	24	3.60	0.00	1.92	2.40	2.40
Biology	76	30.90	0.00	3.80	7.60	26.60
Socioeconomic	33	3.30	1.65	13.20	16.50	4.95
Legal/Institutional	66	4.62	9.90	13.20	3.30	3.30
Total	330	59.77	67.55	47.84	45.50	59.45

Table A-2 -- Continued

COMPARATIVE VALUE PERSPECTIVES RANKING

Indicator	Unweighted Raw Score	Weighted Score				
		Environmentalists	Mining Companies	Local Government	Local Citizens	SRI Study Team
Tract 5						
Coal Resource Economics	5	0.15	4.00	0.25	0.25	0.50
Hydrology/Water Quality	85	21.25	0.00	17.00	17.00	21.25
Air Quality	94	14.10	0.00	7.52	9.40	9.40
Biology	76	30.40	0.00	3.80	7.60	26.60
Socioeconomic	33	3.30	1.65	13.20	16.50	4.95
Legal/Institutional	54	3.78	8.10	4.30	2.70	2.70
Total	347	72.98	13.75	46.07	53.45	65.40
Tract 6						
Coal Resource Economics	37	1.11	29.60	1.85	1.85	3.70
Hydrology/Water Quality	71	17.75	0.00	14.20	14.20	17.75
Air Quality	39	5.85	0.00	3.12	3.90	3.90
Biology	58	23.20	0.00	2.70	5.80	20.30
Socioeconomic	32	3.20	1.60	12.80	16.00	4.80
Legal/Institutional	57	3.99	8.55	11.40	2.85	2.85
Total	294	55.10	39.75	46.27	44.60	53.30
Tract 7						
Coal Resource Economics	11	0.33	8.80	0.55	0.55	1.10
Hydrology/Water Quality	67	16.75	0.00	13.40	13.40	16.75
Air Quality	94	14.10	0.00	7.52	9.40	9.40
Biology	53	21.20	0.00	2.65	5.30	18.55
Socioeconomic	33	3.30	1.65	13.20	16.50	4.95
Legal/Institutional	51	3.57	7.65	10.20	2.55	2.55
Total	309	59.25	18.10	47.52	47.70	53.30
Tract 8						
Coal Resource Economics	100	3.00	80.00	5.00	5.00	10.00
Hydrology/Water Quality	62	15.50	0.00	12.40	12.40	15.50
Air Quality	50	7.50	0.00	4.00	5.00	5.00
Biology	53	21.20	0.00	2.65	5.50	18.55
Socioeconomic	33	3.30	1.65	13.20	16.50	4.95
Legal/Institutional	43	3.01	6.45	8.60	2.15	2.15
Total	341	53.51	88.10	45.85	46.55	56.15

Table A-2 -- Concluded

COMPARATIVE VALUE PERSPECTIVES RANKING

Indicator	Unweighted Raw Score	Weighted Score				
		Environmentalists	Mining Companies	Local Government	Local Citizens	SRI Study Team
Tract 9						
Coal Resource Economics	0	0.00	0.00	0.00	0.00	0.00
Hydrology/Water Quality	43	10.75	0.00	8.60	8.60	10.75
Air Quality	100	15.00	0.00	8.00	10.00	10.00
Biology	76	30.40	0.00	3.80	7.60	26.60
Socioeconomic	32	3.20	1.60	12.80	16.00	4.80
Legal/Institutional	60	4.20	9.00	3.00	3.00	3.00
Total	311	63.55	10.60	36.20	45.20	55.15
Tract 10						
Coal Resource Economics	26	0.78	20.80	1.30	1.30	2.60
Hydrology/Water Quality	45	11.25	0.00	9.00	9.00	11.25
Air Quality	100	15.00	0.00	8.00	10.00	10.00
Biology	76	30.40	0.00	3.80	7.60	26.60
Socioeconomic	32	3.20	1.60	12.80	16.00	4.80
Legal/Institutional	55	3.80	8.25	11.00	2.75	2.75
Total	334	64.43	30.65	45.90	46.65	58.00
Tract 11						
Coal Resource Economics	23	0.69	18.40	1.15	1.15	2.30
Hydrology/Water Quality	84	21.00	0.00	16.80	16.80	21.00
Air Quality	97	14.55	0.00	7.76	9.70	9.70
Biology	76	30.40	0.00	3.80	7.60	26.60
Socioeconomic	32	3.20	1.60	12.80	16.00	4.80
Legal/Institutional	51	3.57	7.65	10.20	2.55	2.55
Total	363	73.41	27.65	52.51	53.80	64.95
Tract 12						
Coal Resource Economics	46	1.38	36.80	2.30	2.30	4.60
Hydrology/Water Quality	58	14.50	0.00	11.60	11.60	14.50
Air Quality	67	10.50	0.00	5.36	6.70	6.70
Biology	76	30.40	0.00	3.80	7.60	26.60
Socioeconomic	33	3.30	1.65	13.20	16.50	4.95
Legal/Institutional	60	4.20	9.00	12.00	3.00	3.00
Total	340	64.28	47.45	48.26	47.70	60.35

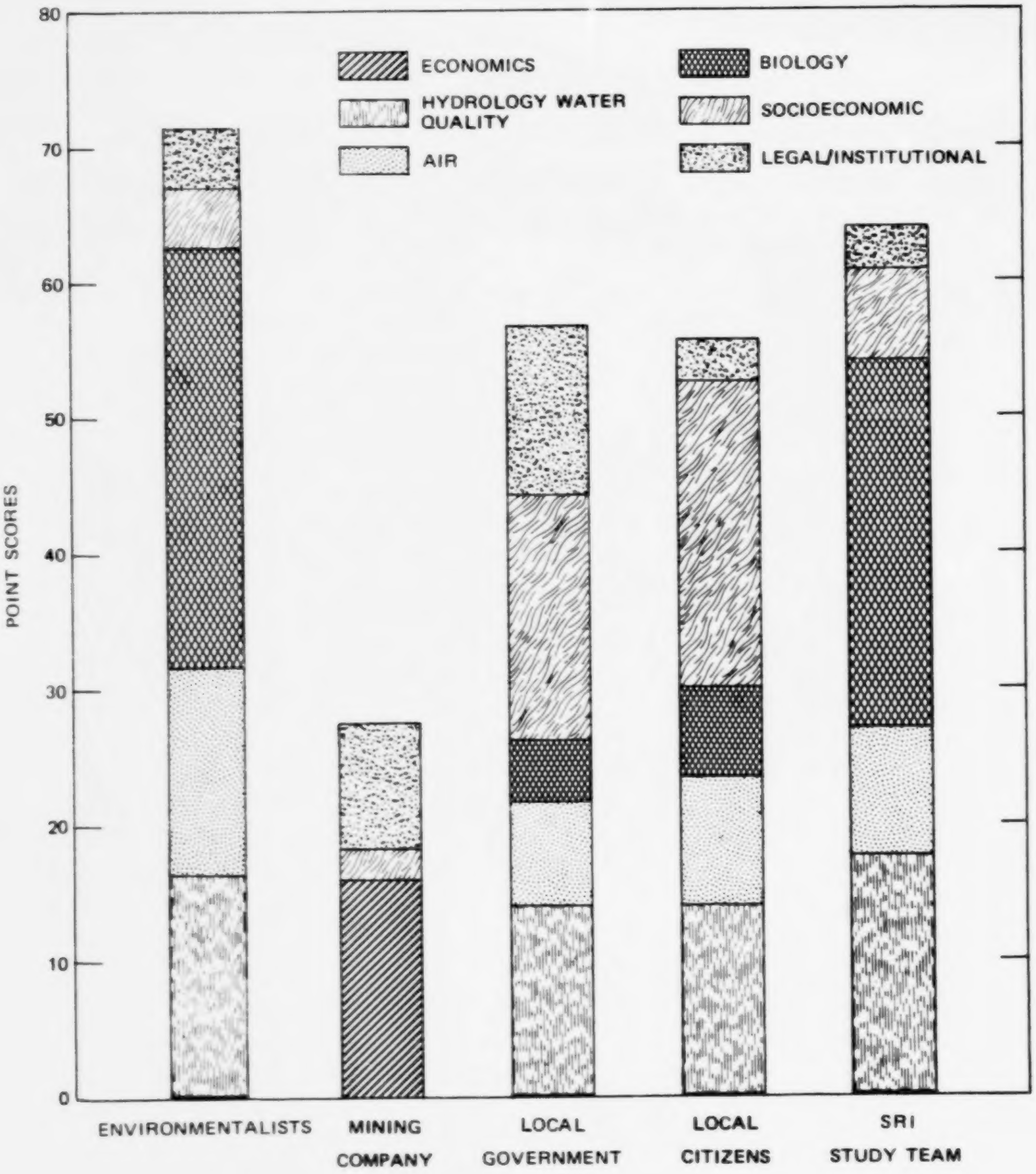

FIGURE A-5. COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 1

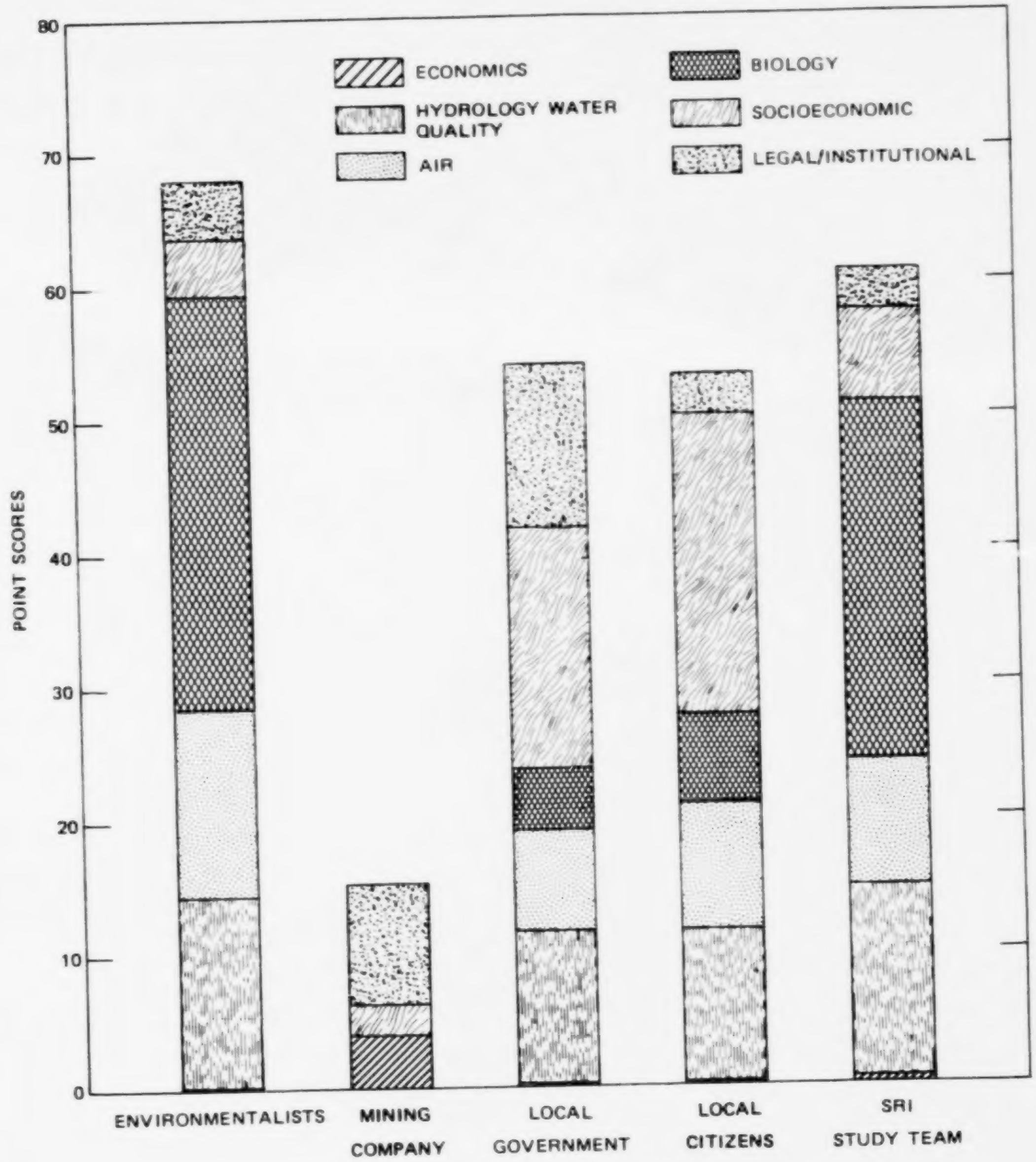

FIGURE A-6. COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 2

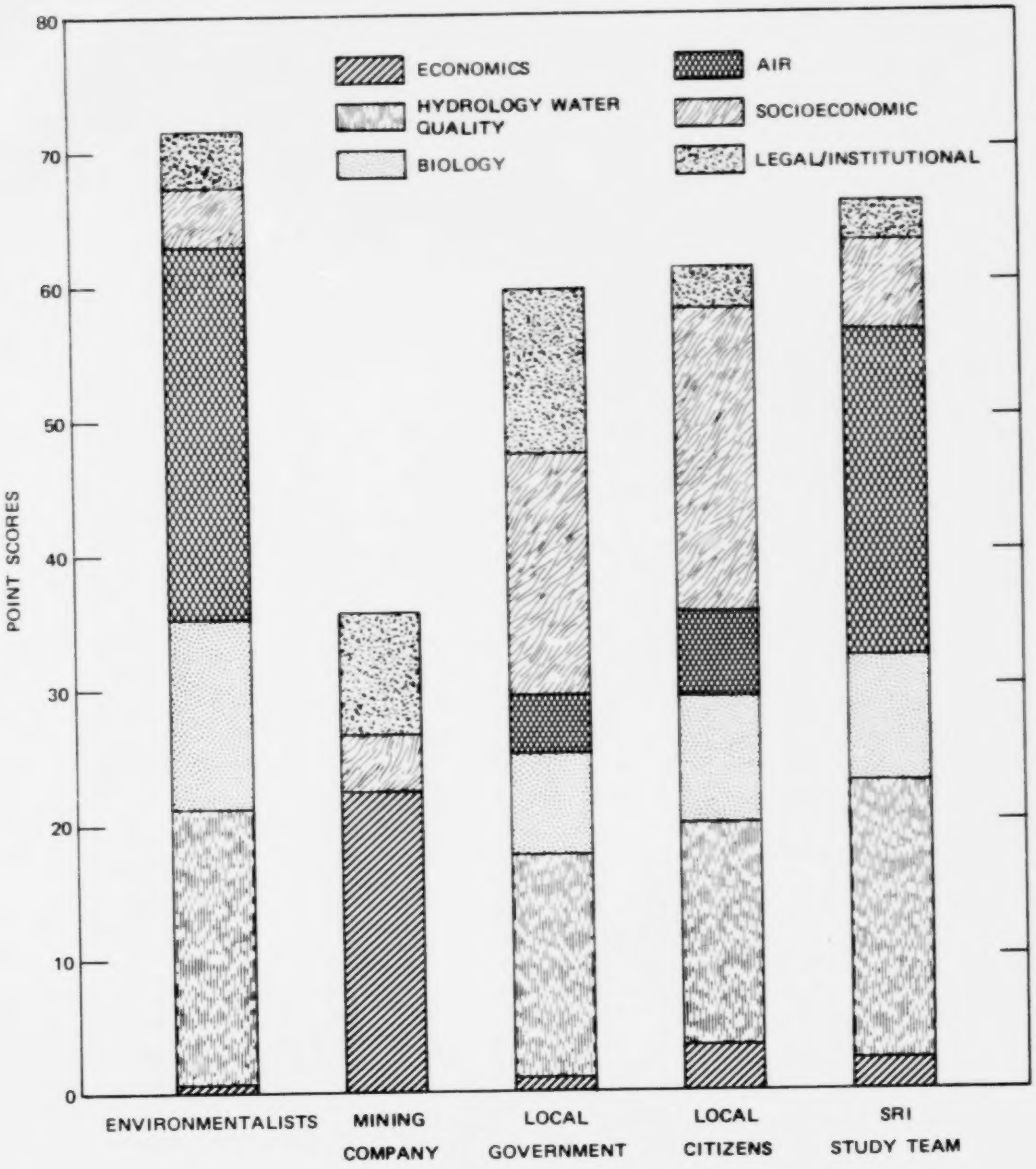

FIGURE A-7. COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 3

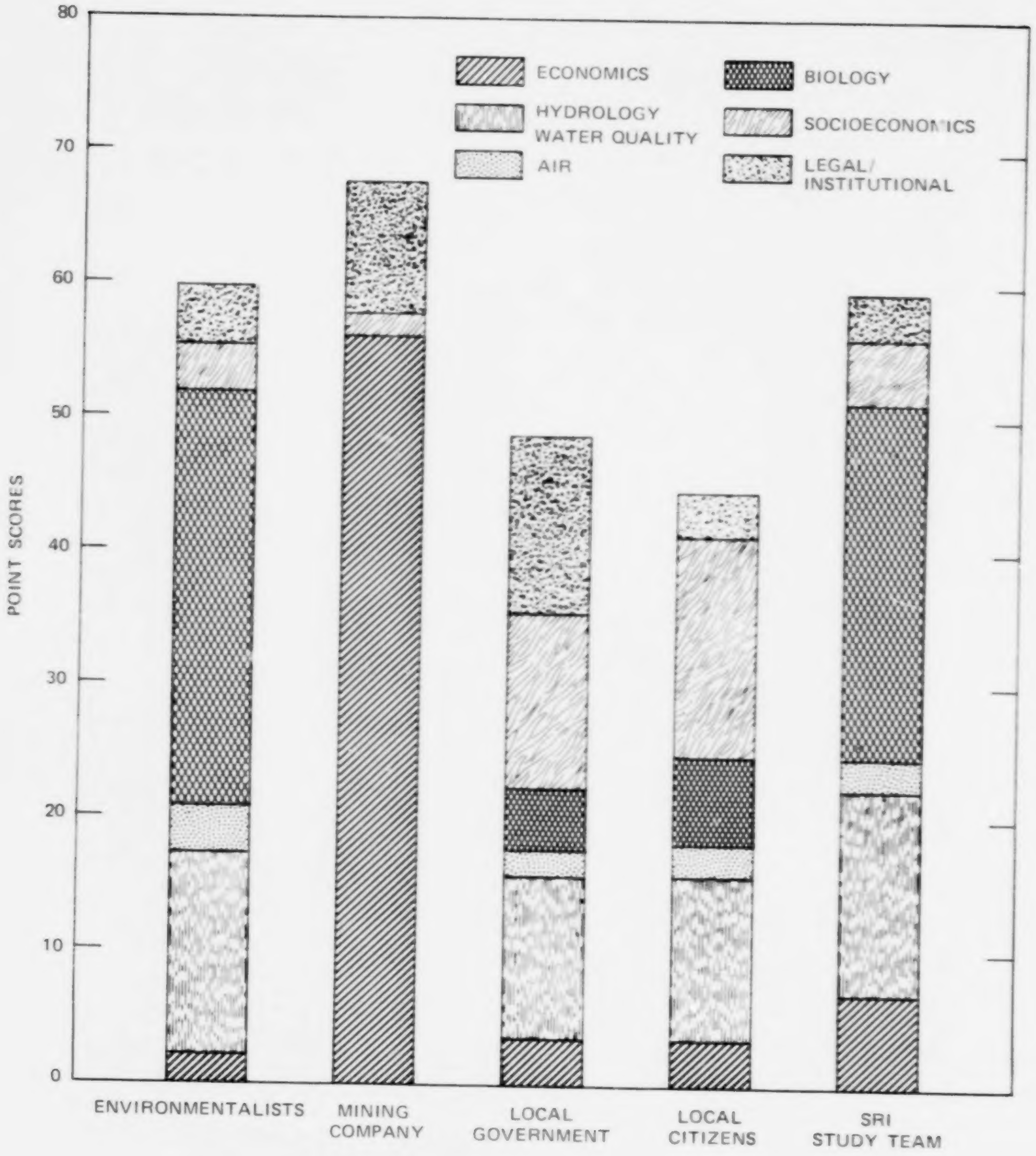

FIGURE A-8. COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 4

[redacted]

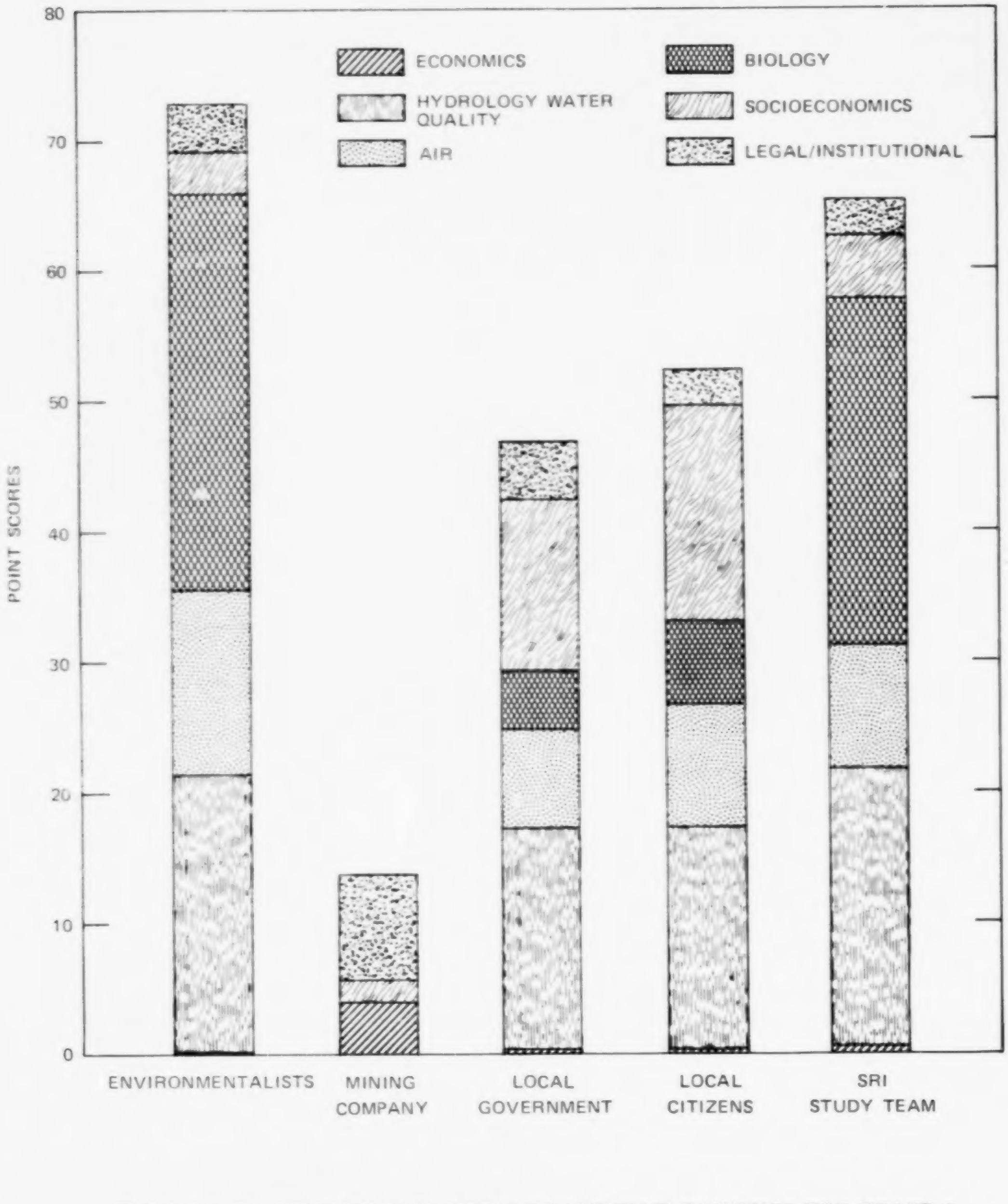

FIGURE A-9. COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 5

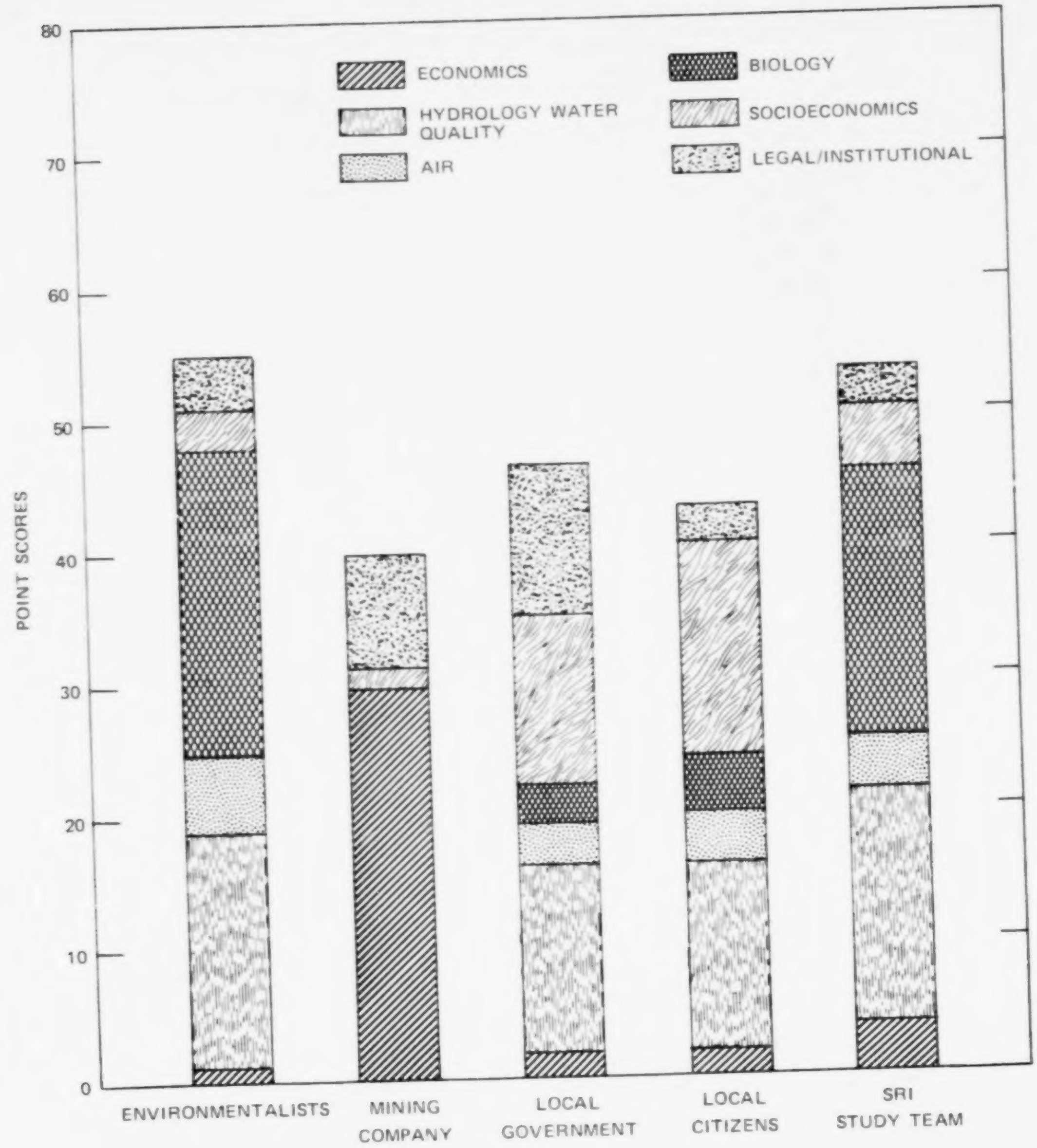

FIGURE A10 COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 6

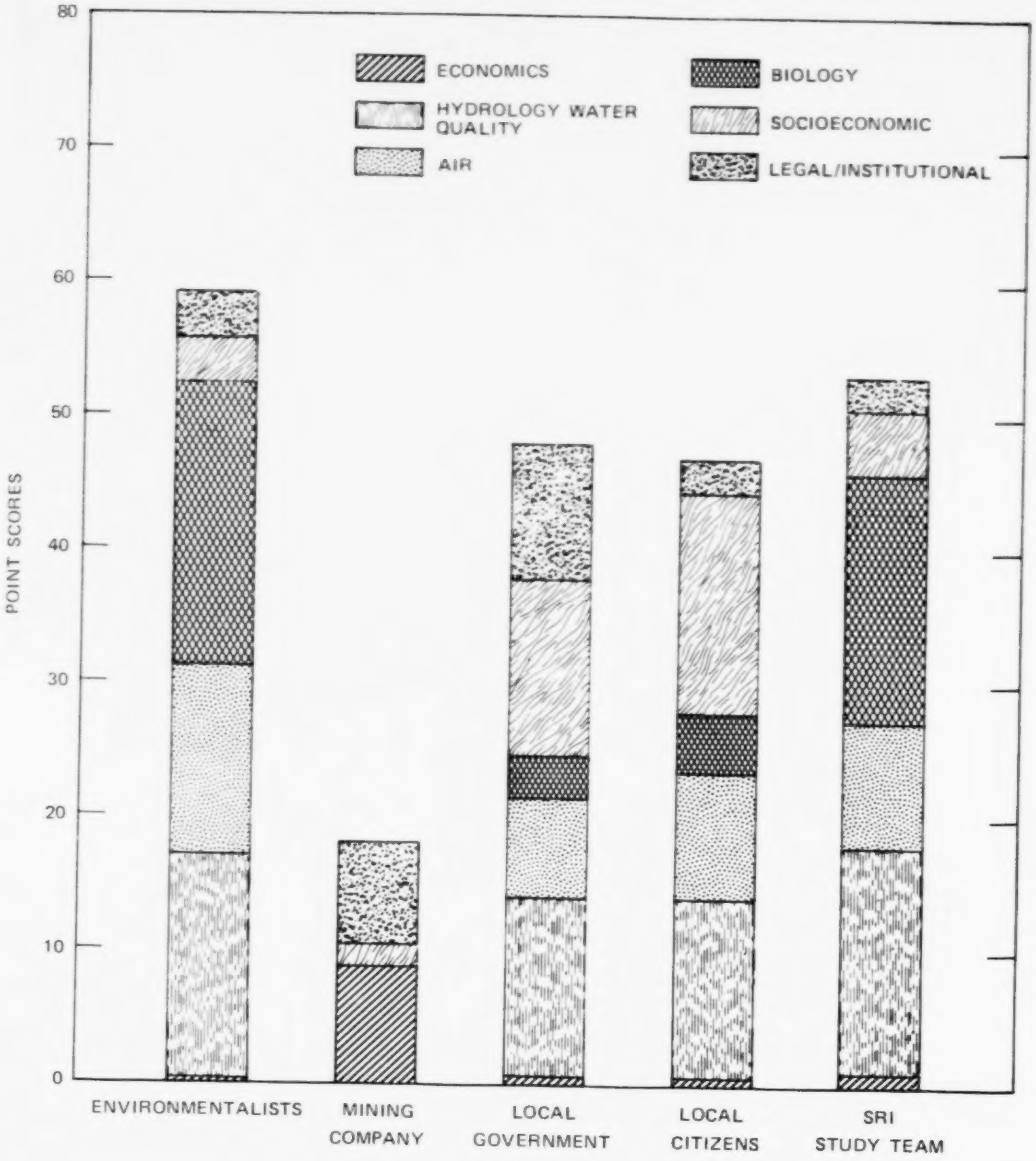

FIGURE A-11 COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 7

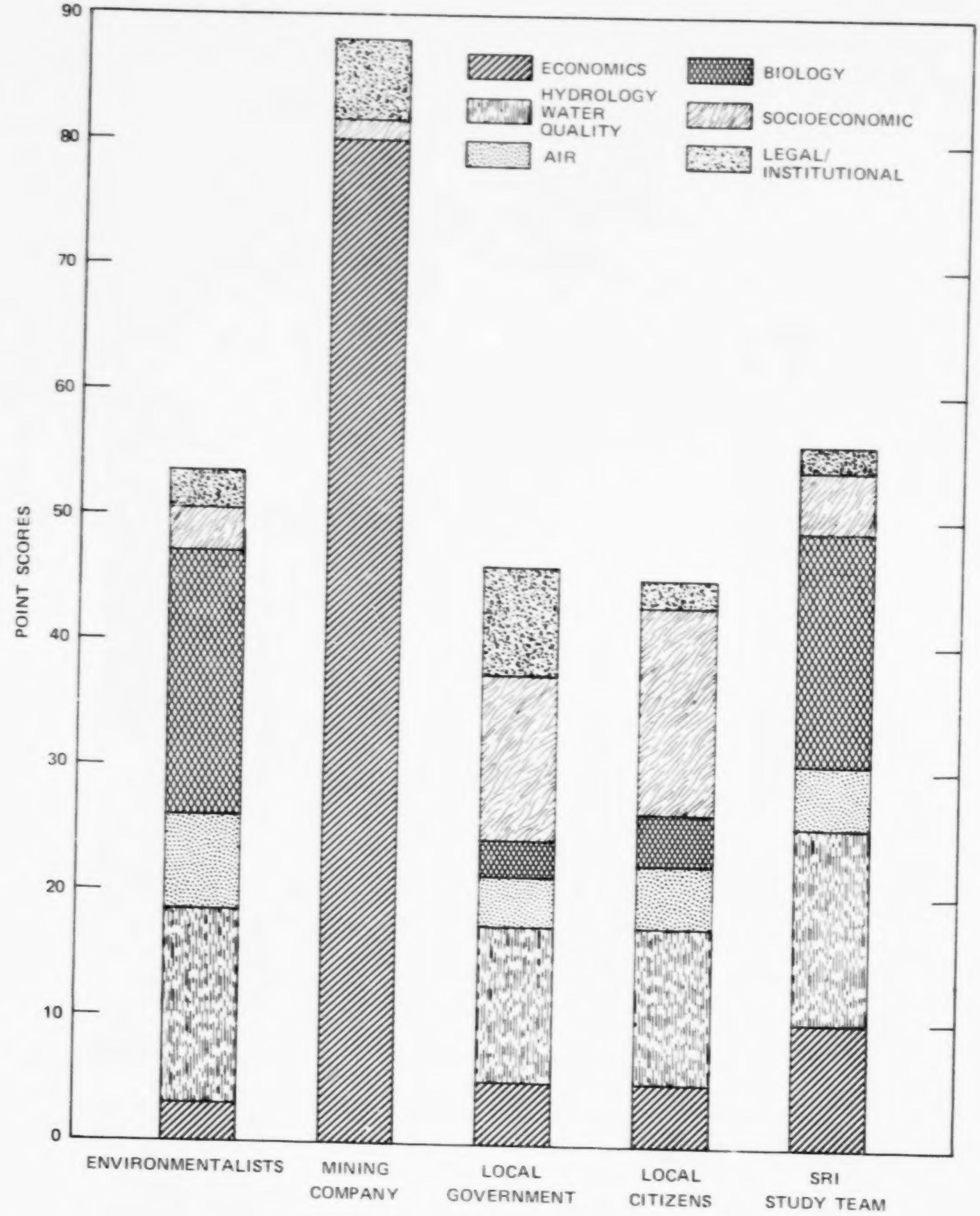

FIGURE A-12. COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 8

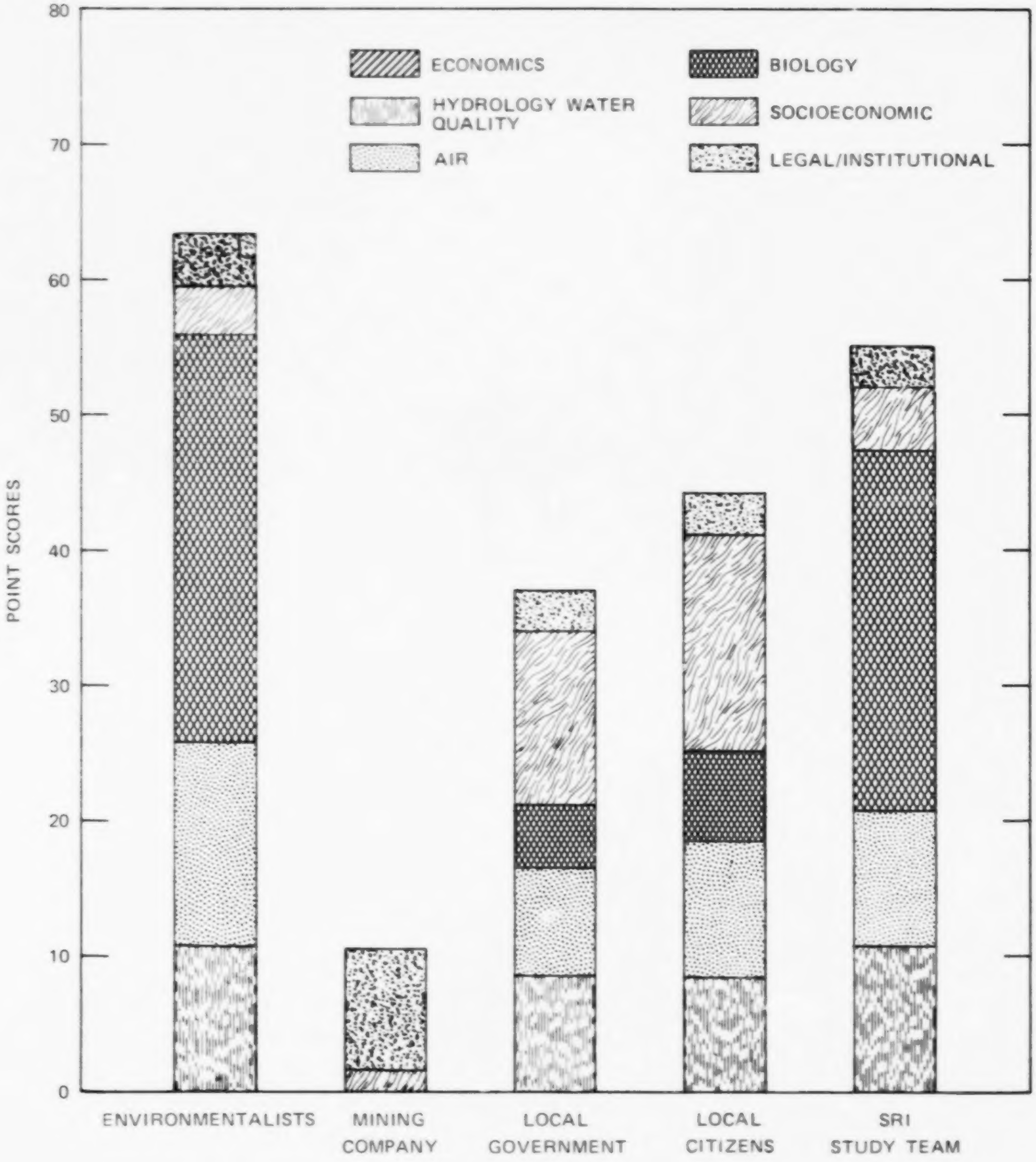

FIGURE A13. COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 9

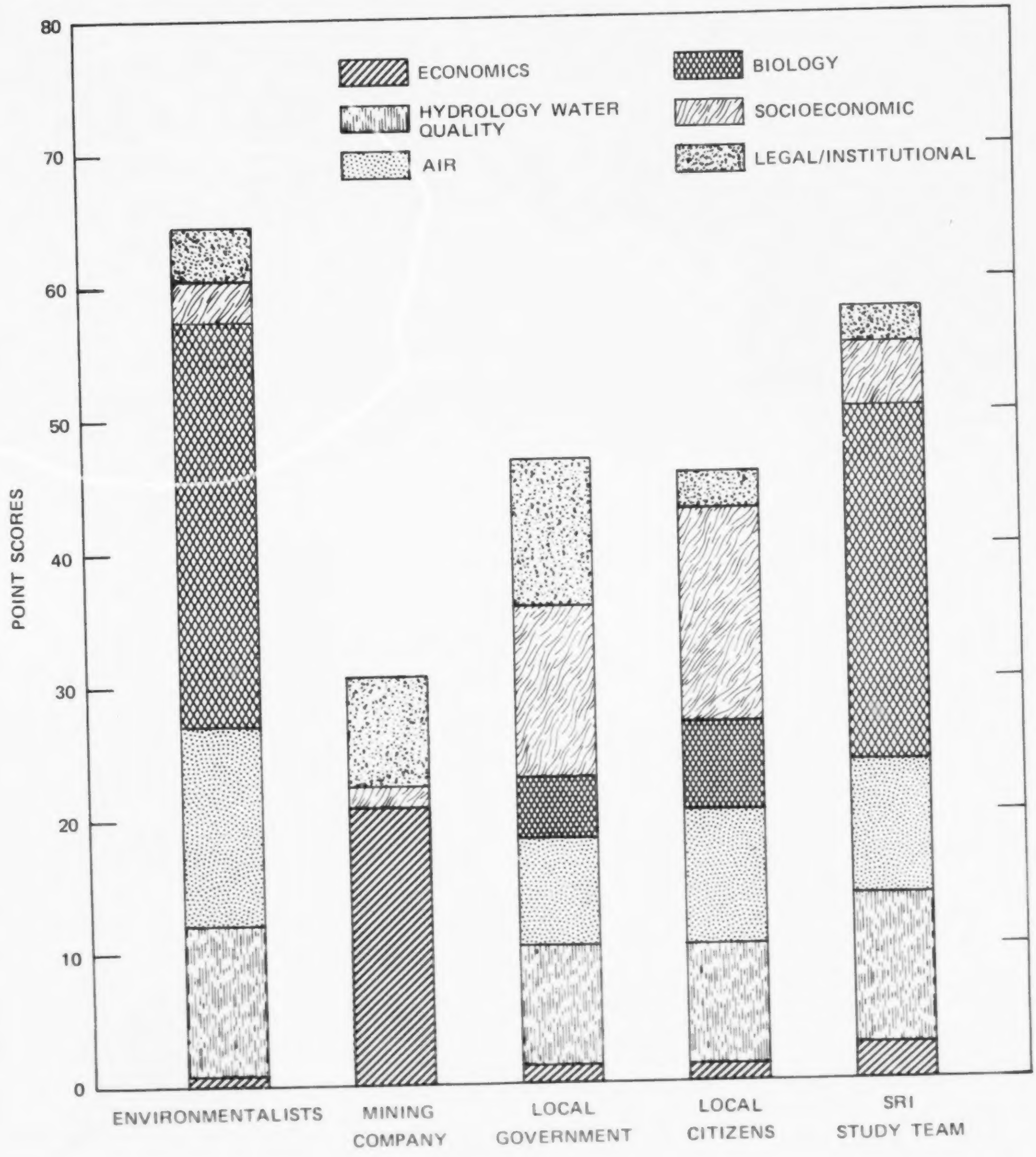

FIGURE A-14. COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 10

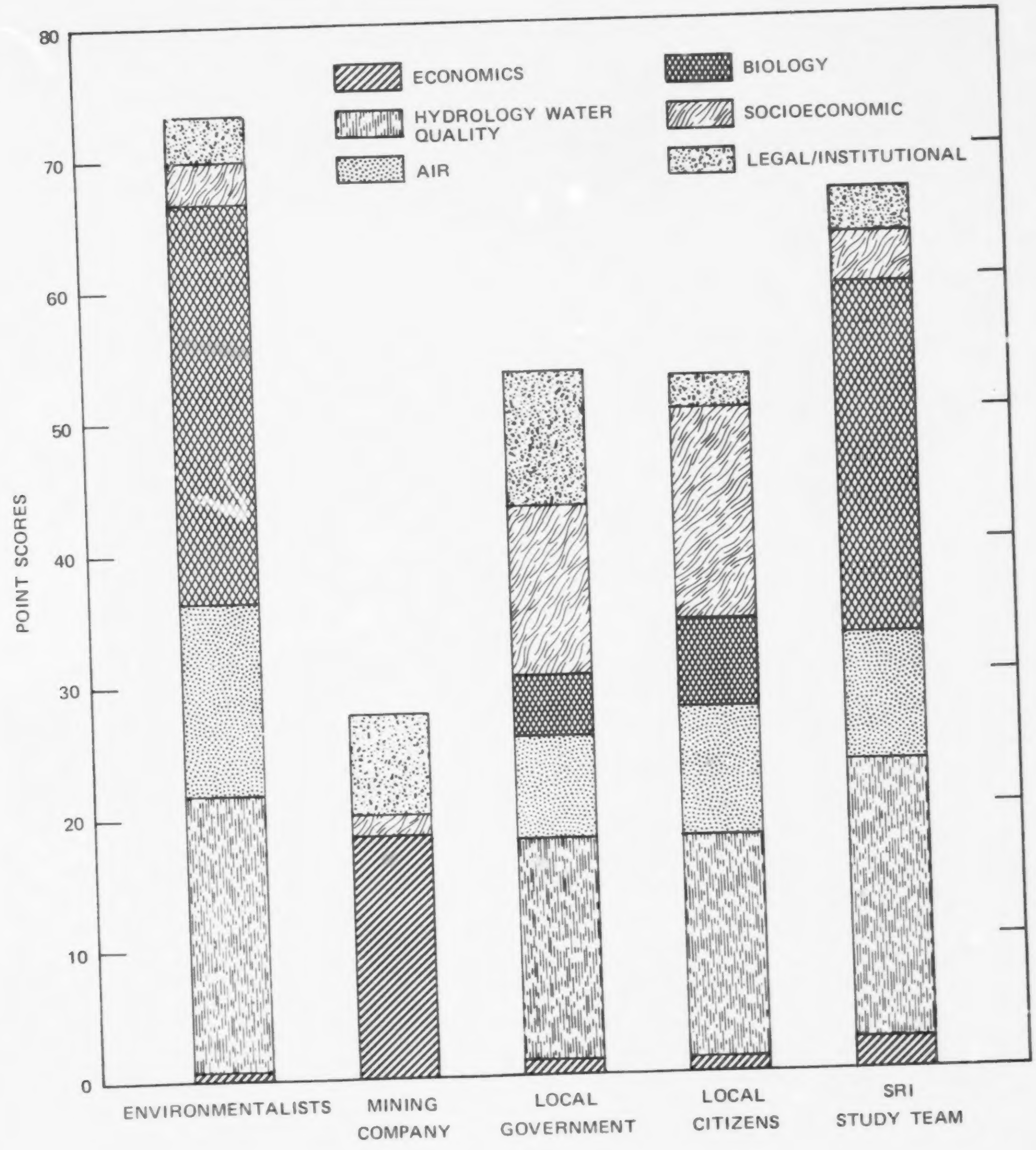

FIGURE A-15. COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 11

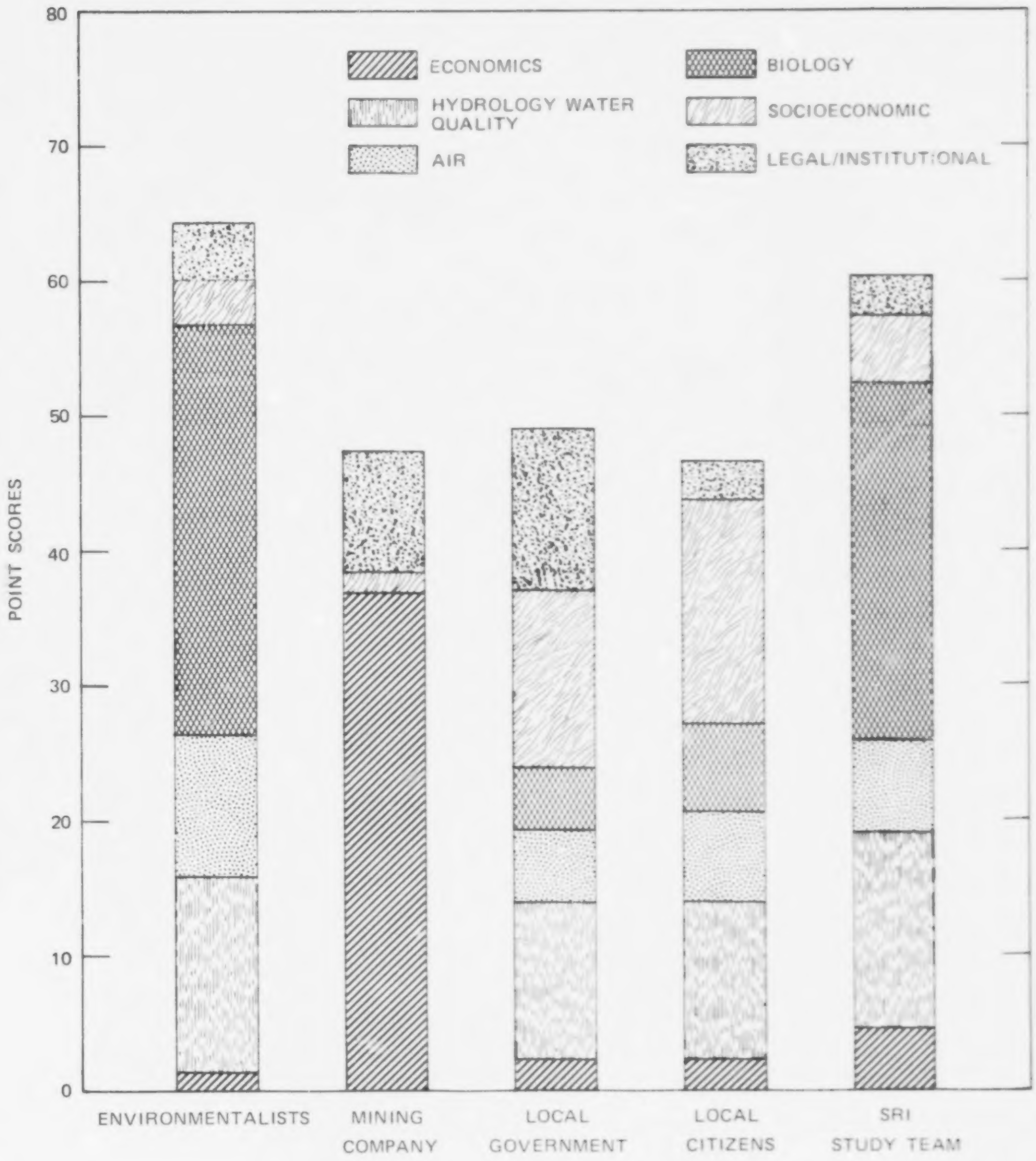

FIGURE A-16. COMPARATIVE VALUE PERSPECTIVE RANKINGS FOR TRACT 12

II. Worksheets

The worksheets for each impact indicator have been completed to demonstrate how the methodology works. An explanation of the results as well as comparative summary sheets are also included to further explain the process and to more clearly illustrate the results.

A. Coal Resource Economics Indicator

Because the USGS maps of these example lease tracts are not available, published Bureau of Mines and USGS sources have been used to obtain estimates. There is wide variation in the published data, and the accuracy of these estimates is therefore probably poor. USGS map data are expected to be much more accurate. The data used here should not be taken too seriously as indicators of the economic value of the tracts described, but they are adequate to illustrate the methodology.

1. Amount of Surface-Minable Coal

The Bureau of Mines Information Circular applicable to the surface-minable coal in Colorado is IC #8713, "Strippable Coal Resources of Colorado," 1976. These estimates show that only 5 of the 12 tracts are estimated by the Bureau of Mines to have enough coal to support a 1 mtpy surface mine (i.e., greater than 17 million tons if the median estimate is used). These tracts do contain many billion tons of coal, according to USGS estimates, but it is nearly all at depths of greater than 150 feet. Therefore, according to currently available information it is not economically feasible to strip mine them, but it is possible that underground mines would be practicable.

2. Price and Heating Value

Estimates of average seam thickness for each of the 12 tracts were obtained from Bureau of Mines data in IC #8713 and are shown in Table A-4. The minimum prices that correspond to these seam thicknesses are shown in Table A-3.

The heating value for the Danforth Hills region (lease tracts 1-5) (obtained from the USGS data base) was not given in the

Bureau of Mines information circular. However, the heating values shown for the remaining lease tracts were given. The mean values listed in the information circular are shown in the table. There is little variation in either the minimum price or the heating value estimates throughout the tracts. Therefore, these variables will have little influence in establishing the ranking of the tracts. If the tracts showed greater differences in seam thickness or heating value, these variables would have been more important.

3. Summary

The three economic variables, amount of coal, minimum price and heating value, are combined in column 5 of Table A-3 in accordance with the formula shown in Chapter II. When the highest value indicator is set to 100 and the others are scaled up by the same factor, the resulting scaled indicators are shown in the next column of the table. Finally, the ranking in accordance with the economic indicator is shown in the last column. The ranking is completely determined in this case by the amount of coal estimated in each tract because of the similarity between the estimates of minimum price and heating value. In general, this would not be the case.

B. Hydrology/Water Quality

1. Effects from Mining

The effects of mining on water quality in northwestern Colorado were generally indicated to be more severe than those on hydrology. Analysis of information contained in the Environmental Impact Statement for Northwest Colorado Coal seems to verify these results. The aquifers in the region have low yields and poor water quality. In addition, perennial streams are few and intermittent drainage is common. Therefore, coal mining activities would release the poor quality water into the environment, causing significant impacts, but it would have a less significant effect on the hydrology.

Table A-3

PRICE, HEATING VALUE, AND INDICATOR

Tract	Quantity (10^6 Tons)	Minimum Price ($/ton)	Heating Value (10^3 Btu/ton)	Unscaled Indicator	Scaled Indicator	Ranking
1	1.1	14.60	11.2	10.8	1	11
2	3.4	14.60	11.2	33.4	4	10
3	16.1	14.60	11.2	158.1	21	7
4	51.5	14.60	11.2	505.6	67	2
5	4.0	14.60	11.2	39.3	5	9
6	25.1	13.00	11.5	271.5	36	4
7	7.1	14.60	11.6	73.4	10	8
8	64.1	11.00	11.5	753.7	100	1
9	0	12.00	11.5	0.0	0	12
10	18.2	12.00	11.6	207.6	28	5
11	15.5	13.00	11.6	169.8	23	6
12	29.1	11.00	11.5	342.2	45	3

2. Averaging

Because the indicator for water required averaging the values for hydrology and water quality for each tract, the differences between the two were reduced. Most tracts had values between 50 and 60, indicating moderate effects from development. These results are reasonable given the characteristics of Northwest Colorado. In addition, the user can review the results for water quality and hydrology, and has the option of weighting one more than the other if warranted.

3. Summary

The methodology gave results for hydrology and water quality that varied by a factor of 2 for the 12 selected lease tracts in northwestern Colorado (see Table A-4). Sufficient differentiation among tracts was also obtained for each individual characteristic (i.e., aquifers intercepted, topography, potable supply). Refer to Tables A-5 and A-6 which contain information used in determining the ranking. For example, Tract 8 had a value of 35 for water quality (moderate to major effect) and a value of 67 for hydrology (moderate to minimal effect). This indicated to the user that development of a coal mine on Tract 8 could result in significant water quality problems, but that hydrological problems might not be as severe. Tract 10, on the other hand, was rated at 45 for water quality and hydrology, indicating that effects on both will be moderate to major.

Table A-4

HYDROLOGY/WATER QUALITY IMPACT INDICATOR

Tract	Water Quality	Hydrology	Average Value	Ranking
1	52	70	61	5
2	60	57	59	7
3	71	82	77	1
4	68	61	65	4
5	66	85	76	2
6	49	71	60	6
7	35	67	51	10
8	35	62	49	11
9	67	43	55	8
10	45	45	45	12
11	51	84	68	3
12	50	58	54	9

HYDROLOGY ELEMENT SUMMARY SHEET

	Weighted Value					
Tract	Percent Recharge	Alluvial Aquifer	Drainage Density	Topography	Potable Supply	Total
1	22.5	16	10	12.5	8.5	70
2	22.5	9	11	6.3	8.5	57
3	23.8	11	17	21.3	8.5	82
4	22.5	8	18	3.8	8.5	61
5	25.0	19	16	16.3	8.5	85
6	22.5	12	8	18.8	9.5	71
7	18.8	8	8	22.5	10	67
8	21.3	4	17	13.8	6	62
9	6.3	7	20	1.3	8	43
10	10	7	11	7.5	9	45
11	22.5	9	19	23.8	9.5	84
12	3.8	15	16	15.0	8.5	58

Table A-5

WATER-BEARING CHARACTERISTICS OF GEOLOGIC FORMATIONS

	Yield (gpm)			Dissolved Solids (mgl)		
Formation	Minimum	Median	Maximum	Minimum	Median	Maximum
Qa, Qg, Qd	5	50	1,500	20	100	2,000
Other Q	1	2	10	20	300	2,000
Tbb, Tui, Tv	2	5	50	20	50	200
Tmi, Taf	2	5	50	20	50	200
Other T	2	10	20	30	1,500	20,000
Kl	2	20	100	200	800	3,000
Kls	1	2	20	600	4,000	10,000
Kwl, Ki, Kmv	1	10	300	200	1,000	8,000
Km	1	2	20	600	4,000	10,000
Kd	2	10	100	100	1,000	10,000
All J	1	10	200	300	1,000	10,000
All T	1	5	100	500	1,500	10,000
All P & P	1	5	100	500	2,000	20,000
M	5	100	2,000	1,000	5,000	20,000
DE	1	10	50	200	500	2,000
Y & X	1	5	50	20	50	200

Note: Formation designations are keyed to the geologic map in Appendix A, from the BLM Final Environmental impact statement for Northwest Colorado coal.

Source: BLM.

Table A-6

CHARACTERISTICS OF GEOLOGIC FORMATIONS

Formation	Thickness	Lithology
Kw	1,100 ft in east to 2,000 ft in west	Twenty Mile sandstone near top
Ki	1,500 ft in east to 1,370 central	Massive sandstone; interbedded shale, siltstone, and coal
Kls	0-1,900 ft; 1,900 ft in central	Marine shale interfingered with Mesa Verde formation to east
Tw	0-6,750 ft	Conglomeritic sandstone interbedded with clay
Tf	2,500-1,400 ft; 1,675 west of Meeker	Medium to coarse sandstone
Two	0-1,000 ft	Sandstone, quartzite; conglomeritic sandstone with clays
Km	5,300 ft at Rangely	Marine shales
Tbb	Unknown	Basalt

HYDROLOGY WORKSHEET

Percent Recharge

Tract	Characteristics	Assigned Value	Weighted Value (x 0.25)
1	about 10% recharge area	90	22.5
2	about 10% recharge area	90	22.5
3	5% recharge area	95	23.8
4	10% recharge area	90	22.5
5	less than 5% recharge area	100	25.0
6	about 10% recharge area	90	22.5
7	15-20% recharge area	75	18.8
8	10-15% recharge area	85	21.3
9	60% recharge area	25	6.3
10	50% recharge area	40	10.0
11	10% recharge area	90	22.5
12	70% recharge area	15	3.8

Comments: Based on analysis of USGS 7½-minute quadrangle maps for each lease tract.

HYDROLOGY WORKSHEET

Alluvial Aquifers

Tract	Characteristics	Assigned Value	Weighted Value (x 0.20)
1	Short stretches perennial streams, 2 intermittent streams; no major discharge areas	80	16
2	3 mi perennial streams; 3 large intermittent streams; several small reservoirs; 2 springs; 2 apparent discharge areas	45	9
3	3 mi perennial streams; 2 intermittent streams; 1 spring; no reservoirs or noticeable discharge areas	55	11
4	5 mi perennial streams; 3 intermittent streams; 3 springs and some ponding; no reservoirs or noticeable discharge areas	40	8
5	No perennial streams; 3 intermittent streams; some ponding; no springs, reservoirs, or discharge areas	95	19
6	4 mi perennial streams; 1 large intermittent stream; some ponding, no springs, reservoirs, or discharge areas	60	12
7	3 mi perennial streams; 5 intermittent streams; 2 reservoirs, 1 intermittent reservoir; Hayden Power Plant ponds; small ponds; no springs or discharge areas	40	8
8	8 mi of the Yampa River; many intermittent tributaries; 1 spring; no reservoirs or discharge areas	20	4
9	2 mi perennial streams; more than 6 intermittent streams; several reservoirs and ponds; 7 springs; no other discharge areas	35	7
10	5 mi perennial streams; 5 intermittent streams; 2 reservoirs and a few ponds; no springs or other discharge areas	35	7
11	4 mi perennial streams; 7 short intermittent streams; 2 ponds; 2 reservoirs; no springs; 1 small discharge area	45	9
12	No perennial streams; 3 large intermittent streams; 5 springs; no ponds, reservoirs, or other discharge areas	75	15

Comments: Based on analysis of USGS 7½-minute quadrangle maps for each lease tract.

HYDROLOGY WORKSHEET

Drainage Density

	Characteristics				
Tract	Cumulative Stream Length (L)	Area of Lease Tract (A)	Drainage Density (L/A)	Assigned Value	Weighted Value (x 0.20)
1	15.5	6.0	2.6	50	10
2	59.0	26.3	2.2	55	11
3	13.5	8.6	1.6	83	17
4	14.5	15.7	0.9	90	18
5	9.5	5.0	1.9	80	16
6	22.0	7.7	2.9	40	8
7	35.5	12.8	2.8	38	8
8	27.0	18.9	1.4	85	17
9	22.5	10.8	0.5	100	20
10	52.0	23.3	2.2	55	11
11	9.0	12.1	0.7	95	19
12	30.0	16.3	1.8	82	16

Comments: Based on analysis of USGS 7½-minute quadrangle maps for each lease tract.

HYDROLOGY WORKSHEET

Topography

Tract	Characteristics	Assigned Value	Weighted Value (x 0.25)
1	Slopes generally 20%; about 10% of area has slopes greater than 50%; small alluvial plains	50	12.5
2	50% of area has slopes of 30% or greater than 40%; 50% has slopes of 20%; fair to extensive alluvial plains	25	6.3
3	80% of area has slopes less than 10%; 20% has slopes greater than 20-30%; fair alluvial plains	85	21.3
4	30% of area has slopes less than 10%; rest have slopes greater than 30%; fair alluvial plains	15	3.8
5	Slopes generally less than 15%; 20% of area has slopes greater than 20%; small alluvial plains	65	16.3
6	Slopes generally 10-15%; entire area 20% or less; fair alluvial plains along major streams	75	18.8
7	90% of area has slopes less than 10%; rest of area has slopes of 20%	90	22.5
8	80% of area has slopes less than 20%; 20% has slopes greater than 40%; large alluvial plains along the Yampa River	55	13.8
9	90% of area has slopes greater than 40%; 10% of area has slopes less than 20%; fair alluvial plains along Waddle Creek	5	1.3
10	50% of area has slopes less than 20%; 20% has slopes greater than 40%; 30% has slopes of 30%; fair alluvial plains along Sage and Dry Creeks	30	7.5
11	Entire area has slopes less than 10%; fair alluvial plains along 1 mi of Foidel Creek	95	23.8
12	Entire area has slopes less than 25%; 70% has slopes less than 20%; no alluvial plains	60	15.0

Comments: Based on analysis of USGS 7½-minute quadrangle maps for each lease tract.

HYDROLOGY WORKSHEET

Potable Supply

Tract	Characteristics	Assigned Value	Weighted Value (x 0.10)
1	80% Kw*; 10% Two; fault in west; synclinal axis	85	8.5
2	90% Kw; 10% Ki; synclines/anticline	85	8.5
3	All Kw; synclinal axis	85	8.5
4	All Kw; syncline in north	85	8.5
5	All Kw; syncline	85	8.5
6	Tw on western half; Tf on eastern half	95	9.5
7	40% Kw; 60% Kls; syncline	100	10.0
8	80% Kw; 10% Qa; 10% Ki; syncline	60	6.0
9	75% Kw; 20% Ki; 5% Km-Tbb; syncline; fault	80	8.0
10	80% Kw; 10% Ki; 10% Kls; syncline in east	90	9.0
11	50% Kw; 25% Ki; 15% Kls; 5 faults; syncline at edge	95	9.5
12	All Kw	85	8.5

Comments: Based on an analysis of hydrologic, geologic, and water quality information contained in the BLM Final Environmental Statement for Northwest Colorado Coal.

*Refers to symbols on geologic map. See attachment for evaluation of yield and water quality for each geologic unit

WATER QUALITY ELEMENT SUMMARY SHEET

	Weighted Value					
Tract	Aquifers Intercepted	Drainage Basin Intercepted	Overburden Storage	Elevation	Present Uses	Total
1	12.5	10	9.5	15	5.0	52.0
2	12.5	18	5.0	18	6.3	59.8
3	15.0	17	7.5	13	18.8	71.3
4	15.0	17	4.0	12	20.0	68.0
5	15.0	18	2.0	13	17.5	65.5
6	11.3	16	5.0	7	10.0	49.3
7	10.0	7	5.0	8	5.0	35.0
8	11.3	5	3.5	8	7.5	35.3
9	10.0	15	10.0	17	15.0	67.0
10	10.0	8	10.0	11	6.3	45.3
11	7.5	17	1.0	10	15.0	50.5
12	15.0	10	6.0	13	6.3	50.3

WATER QUALITY WORKSHEET

Aquifers Intercepted

Tract	Characteristics	Assigned Value	Weighted Value (x 0.25)
1	80% Kw*; 10% Two; fault in west; synclinal axis	50	12.5
2	90% Kw; 10% Ki; synclines/anticline	50	12.5
3	All Kw; synclinal axis	60	15.0
4	All Kw; syncline in north	60	15.0
5	All Kw; syncline	60	15.0
6	Tw on western half; Tf on eastern half	45	11.3
7	40% Kw; 60% Kls; syncline	40	10.0
8	80% Kw; 10% Qa; 10% Ki; syncline	45	11.3
9	75% Kw; 20% Ki; 5% Km-Tbb; syncline; fault	40	10.0
10	80% Kw; 10% Ki; 10% Kls; syncline in east	40	10.0
11	50% Kw; 25% Ki; 15% Kls; 5 faults; syncline at edge	30	7.5
12	All Kw	60	15.0

Comments: Based on an analysis of hydrologic, geologic, and water quality information contained in the BLM Final Environmental Statement for Northwest Colorado Coal.

* Refers to symbols on geologic map.

WATER QUALITY WORKSHEET

Drainage Basin Intercepted

Tract	Characteristics	Assigned Value	Weighted Value (x 0.20)
1	Located on Sulphur Creek (intermittent) in the White River Basin	50	10
2	Located on James Creek that flows into Good Spring Creek and drains north; southern part has interior drainage; 9-mile Draw is intermittent and drains south into Coal Creek	90	18
3	Located on Wilson Creek; flows north into Milk Creek; 2 intermittent streams drain north	85	17
4	Located on Morgan Gulch; flows north toward Axial Basin	85	17
5	Located on an unnamed tributary of Good Spring Creek	90	18
6	Located on Dry Fork of Little Bear Creek; drains southwest into Fortification Creek	80	16
7	Located on Sage Creek (1 mi upstream from the Yampa River) and Scotchman's Gulch (flows into Grassy Creek and then to Yampa)	35	7
8	Located on Yampa River	25	5
9	Located 4 mi upstream from Williams Fork on Waddle Creek	75	15
10	Located on Sage and Dry Creeks, 7.5 and 8.5 mi upstream from Yampa	40	8
11	Located on Foidel Creek and Middle Creek	85	17
12	No perennial stream; at headwaters of some intermittent tributaries of the Yampa (6 mi away); 3 large intermittent tributaries flow into Williams Fork (2 mi away)	50	10

Comments: Based on analysis of USGS 7½-minute quadrangle maps for each lease tract. Unless otherwise noted, all streams mentioned are perennial (as indicated on the USGS map). The White River Basin has a drainage area of 762 mi^2; Yampa River has one of about 800 mi^2; Williams Fork is 150 mi^2; Fortification Creek is 180 mi^2. Estimates of distances downstream to a major basin were made from a USGS map of scale 1:350,000.

WATER QUALITY WORKSHEET

Overburden Storage

Tract	Characteristics			Assigned Value	Weighted Value (x 0.10)
	Number of Storage Sites	Storage Volume (10^6 yd^3)	Overburden (10^6 yd^3)		
1	7	219	93	95	9.5
2	2	132	93	50	5.0
3	2	176	93	75	7.5
4	3	240	186	40	4.0
5	2	79	93	20	2.0
6	3	149	109	50	5.0
7	2	135	93	50	5.0
8	2	184	136	35	3.5
9	3	279	75	100	10.0
10	3	267	75	100	10.0
11	3	47	83	10	1.0
12	3	177	113	60	6.0

Comments: Based on analysis of USGS 7½-minute quadrangle maps for each lease tract.

WATER QUALITY WORKSHEET

Elevation

Tract	Characteristics: Elevation Range (ft)	Characteristics: General Elevation (ft)	Assigned Value	Weighted Value (x 0.20)
1	7,000-8,000	7,400	75	15
2	7,000-8,600	7,600-7,800	90	18
3	6,600-7,600	7,200-7,400	65	13
4	6,500-8,300	7,200	60	12
5	6,600-8,100	7,200-7,400	65	13
6	6,400-6,900	6,600	35	7
7	6,500-7,400	6,600-6,800	40	8
8	6,000-7,400	6,600-6,800	40	8
9	6,700-8,500	7,400-7,600	85	17
10	6,500-8,300	7,000-7,200	55	11
11	6,800-7,700	7,000	50	10
12	6,600-7,000	7,200-7,400	65	13

Comments: Based on analysis of USGS 7½-minute quadrangle maps for each lease tract.

WATER QUALITY WORKSHEET

Current Uses

Tract	Characteristics	Assigned Value	Weighted Value (x 0.25)
1	4 mi N/NE Meeker	20	5.0
2	5 mi NE Meeker	25	6.3
3	15 mi N/NE Meeker	75	18.8
4	16 mi N Meeker	80	20.0
5	14 mi NE Meeker	70	17.5
6	8 mi NE Craig	40	10.0
7	4 mi SE Hayden	20	5.0
8	6 mi SW Craig	30	7.5
9	12 mi S Craig	60	15.0
10	5 mi S Hayden	25	6.3
11	12 mi SE Hayden	60	15.0
12	5 mi S Craig	25	6.3

Source: Based on analysis of USGS topographic maps of scale 1:350,000.

C. Air Quality

1. Assumptions

To obtain some differentiation among tracts and to test the methodology fairly, we assumed a 15-year life for all mines and that available coal resources could be surface mined a recovery factor of 0.9 was assumed. Those tracts possessing more than one mine's 15-year supply of coal were assumed to have more than one mine working at the same time. As a result, these tracts had more fugitive dust emissions and received a lower air quality rating. Better information than we have at present on the actual coal resources and overburden is necessary for an adequate assessment of the potential effects of development on air quality.

2. Rankings

The total points for each lease tract clearly illustrate the important similarities among them. Only a few differ by more than a few points.

3. Summary

The results for the Air Quality Indicator show that the methodology is heavily dependent on the size of the operation and on the amount of overburden (see Table A-7). Because each tract is ranked relative to the others, it is essential to have a good understanding of the coal resources and the amount of overburden to obtain adequate differentiation among tracts. However, available data indicated that adequate surface-minable coal is not present and that reserves are not sufficient for the standard 30-year mine in Northwest Colorado. (See discussion in the Coal Resource Economics example.)

Table A-7

AIR QUALITY

Tract	Total	Ranking
1	94	8
2	94	7
3	94	6
4	24	12
5	94	5
6	39	11
7	94	4
8	50	10
9	100	1
10	100	2
11	97	3
12	67	9

AIR QUALITY IMPACT INDICATOR

Tract	Weighted Value			Total
	Mining Operation	Haul Road Traffic	Wind Erosion	
1	45	35	13.5	94
2	45	35	13.5	94
3	45	35	13.5	94
4	5	17.5	1.5	24
5	45	35	13.5	94
6	15	19.3	4.5	39
7	45	35	13.5	94
8	25	17.5	7.5	50
9	50	35	15	100
10	50	35	15	100
11	47.5	35	14.3	97
12	35	21	10.5	67

AIR QUALITY WORKSHEET

Mining Operations

Tract	Characteristics Volume of Overburden (10^6 yd^3/yr)	Assigned Value	Weighted Value (x 0.50)
1	6	90	45
2	6	90	45
3	6	90	45
4	14	10	5
5	6	90	45
6	12	30	15
7	6	90	45
8	10	50	25
9	5	100	50
10	5	100	50
11	5.5	95	47.5
12	8	70	35

Comments: Based on data obtained from coal mining model. A 15-year life is assumed for each tract.

AIR QUALITY WORKSHEET

Haul Road Traffic

Tract	Characteristics Coal Mined (10^6 tons/yr)	 Estimated Truckloads (10^3/yr)	Assigned Value	Weighted Value (x 0.35)
1	1.1	22	100	35
2	1.1	22	100	35
3	1.1	22	100	35
4	2.2	44	50	17.5
5	1.1	22	100	35
6	2.1	42	55	19.3
7	1.1	22	100	35
8	2.2	44	50	17.5
9	1.1	22	100	35
10	1.1	22	100	35
11	1.1	22	100	35
12	1.8	36	60	21

Comments: Based on data from coal mining model, including the following:

10^6 Ton/Yr Mine	2×10^6 Ton/Yr Mine
24-50 ton trucks (overburden)	48-50 ton trucks (overburden)
5-50 ton trucks (coal)	10-50 ton trucks (coal)
Total capacity = 1,450 tons	Total capacity = 2,900 tons

AIR QUALITY WORKSHEET

Wind Erosion

Tract	Characteristics Surface Area Exposed (acres/two year)	Assigned Value	Weighted Value (x 0.15)
1	154	90	13.5
2	154	90	13.5
3	154	90	13.5
4	340	10	1.5
5	154	90	13.5
6	288	30	4.5
7	154	90	13.5
8	246	50	7.5
9	124	100	15.0
10	124	100	15.0
11	136	95	14.3
12	202	70	10.5

Comments: A 15-year life is assumed for each tract.

D. Biological Impact Indicator

Because the data required to perform the preferred method for Northwestern Colorado were not available to us at the time this test of the methodology was applied, we took the opportunity to test the more cumbersome default procedure. Accordingly, all the data and discussions that follow are for the default procedure.

The overall ratings of potential biological impact clustered strongly as a consequence of the similarity of the sites, because few species dominated the assessments of potential for recovery, and the reliance on a rather small number of index values within each scale. However, it does seem from a survey of the study area that the clusters are probably real.

The indices for reclamation potential for soils within the KRCRA's spanned a broad range and compared well with the local BLM staff's assessments when allowances were made for the factor of slope being excluded from our index. Nonetheless, the assessments of reclamation potential are consistently high and the range of values vary only slighly for the 12 tracts, reflecting the presence of only two or three relatively favorable soil types in the lease tracts examined.

Similarly, the absence of reports of rare species other than those with state or federal protection result in a clustering of the index values for rare species.

The values for habitat uniqueness are the most diversified even though they cluster toward the high end of the scale. Interestingly, the components of these index values are quite diverse (see the worksheets). However, the high and low values for items such as scientific value, criticality, and commonness tend to cancel out to give relatively high values when combined.

It would appear that, unless rare species are present on some tracts but not on others, very similar tracts are unlikely to be differentiated by the biological indicator. Perhaps the biological significance of such tracts should be rated by someone so familiar with them that the rater need not resort to the formal procedures. Table A-8 illustrates the findings and compares the results for these 12 tracts.

Table A-8

SUMMARY OF THE BIOLOGICAL ELEMENTS FOR THE TWELVE TEST TRACTS

Tract Number	Reclamation Potential	Important Species	Habitat Uniqueness	Overall Ranking
1	99	60	70	77
2	99	60	70	77
3	98	60	50	69
4	98	60	70	76
5	98.5	60	70	76
6	98	1	55	48
7	98	1	76	58
8	97.5	1	61	53
9	99	60	70	76
10	99	60	70	76
11	99	60	70	76
12	99	60	70	76

Worksheet for Biological Impact Indicators

Tract No. 1

1. Reclamation potential[a]		
a. Table V-1		
b. Alternative Table (see text)	99	99
Notes: Soil #59		
2. Important species (Table V-2)		60
Notes: None present		
3. Habitat Uniqueness[a]		
a. Expert opinion		
b. Table V-4		
Commonness	25	
Criticality	10	
Scientific value	10	
Combinations	25	
Sum of above four items	70	70
Notes: Winter range for deer		
4. Total of items 1-3		229
5. Divide total by 3		76.6
6. Adjustments of line 5[b]		77
7. Additional Comments:		

---

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 2

1. Reclamation potential[a]		
a. Table V-1		
b. Alternative Table (see text)	99	99
Notes: Soil #59		
2. Important species (Table V-2)		60
Notes:		
3. Habitat Uniqueness[a]		
a. Expert opinion		
b. Table V-4		
Commonness	25	
Criticality	10	
Scientific value	10	
Combinations	25	
Sum of above four items	70	70
Notes:		
4. Total of items 1-3		229
5. Divide total by 3		76.6
6. Adjustments of line 5[b]		77
7. Additional Comments:		

---

[a] Use only one of the two methods, for computing the data.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 3

1. Reclamation potential[a]		
a. Table V-1	98-99	
b. Alternative Table (see text)		98
Notes: Mostly soil #21, some #59		
2. Important species (Table V-2)		60
Notes:		
3. Habitat Uniqueness[a]		
a. Expert opinion		
b. Table V-4		
Commonness	25	
Criticality	5	
Scientific value	10	
Combinations	10	
Sum of above four items	50	50
Notes: Chukar; grouse (?); deer winter range, possible elk calving grounds		
4. Total of items 1-3		208
5. Divide total by 3		69.3
6. Adjustments of line 5[b]		69

7. Additional Comments:

---

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 4

1. Reclamation potential[a]		
a. Table V-1		
b. Alternative Table (see text)	98-99	98
Notes: Mostly #21, some #59		
2. Important species (Table V-2)		60
Notes:		
3. Habitat Uniqueness[a]		
a. Expert opinion		
b. Table V-4		
Commonness	25	
Criticality	10	
Scientific value	10	
Combinations	25	
Sum of above four items	70	70
Notes:		
4. Total of items 1-3		228
5. Divide total by 3		76
6. Adjustments of line 5[b]		76

7. Additional Comments:

---

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 5

1. Reclamation potential[a]		
a. Table V-1		
b. Alternative Table (see text)		
Notes: Soil #21 and #59 (about 50/50)	98-99	98.5
2. Important species (Table V-2)		60
Notes:		
3. Habitat Uniqueness[a]		
a. Expert opinion		
b. Table V-4		
Commonness	25	
Criticality	10	
Scientific value	10	
Combinations	25	
Sum of above four items	70	70
Notes: Some elk winter range		
4. Total of items 1-3		228.5
5. Divide total by 3		76.2
6. Adjustments of line 5[b]		76

7. Additional Comments:

---

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 6

1. Reclamation potential[a]
   a. Table V-1
   b. Alternative Table (see text) 98 98
   Notes: Soil #21

2. Important species (Table V-2) 1

   Notes: Greater Sand Hill Crane may be present

3. Habitat Uniqueness[a]
   a. Expert opinion
   b. Table V-4
      Commonness 25
      Criticality 10
      Scientific value 10
      Combinations 10
      Sum of above four items 55 55

   Notes: Low values may be too low

4. Total of items 1-3 144

5. Divide total by 3 48

6. Adjustments of line 5[b] 48

7. Additional Comments: Field check or follow-ups with local wildlife expert is warranted if this tract is other desireable.

---

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 7

1. Reclamation potential[a]		
a. Table V-1		
b. Alternative Table (see text)		
Notes: Soil #21 and #59 (mostly #21)	98	98
2. Important species (Table V-2)		1
Notes: Greater Sandhill Crane present		
3. Habitat Uniqueness[a]		
a. Expert opinion		
b. Table V-4		
Commonness	25	
Criticality	1	
Scientific value	25	
Combinations	25	
Sum of above four items	76	76
Notes: Sharp-tail strutting ground; elk winter range; near airport		
4. Total of items 1-3		175
5. Divide total by 3		58.3
6. Adjustments of line 5[b]		58

7. Additional Comments:

---

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 8

1. Reclamation potential[a]
   a. Table V-1
   b. Alternative Table (see text)
   Notes: Soils largely #35 and #21 with some #59 97.5 97.5

2. Important species (Table V-2) 1
   Notes: Partially includes sandhill crane nesting areas

3. Habitat Uniqueness[a]
   a. Expert opinion
   b. Table V-4
   Commonness
   Criticality 25
   Scientific value 1
   Combinations 10
   Sum of above four items 25
   61 61
   Notes: elk winter range; sandhill crane nesting

4. Total of items 1-3 159.5

5. Divide total by 3 53.2

6. Adjustments of line 5[b] 53

7. Additional Comments:

---

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 9

1. Reclamation potential[a]		
a. Table V-1		
b. Alternative Table (see text)	99	99
Notes: Soil #59		
2. Important species (Table V-2		60
Notes: None present		
3. Habitat Uniqueness[a]		
a. Expert opinion		
b. Table V-4		
Commonness	25	
Criticality	10	
Scientific value	10	
Combinations	25	
Sum of above four items	70	70
Notes: Elk wintering grounds; grouse		
4. Total of items 1-3		229
5. Divide total by 3		76.3
6. Adjustments of line 5[b]		76
7. Additional Comments:		

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 10

1. Reclamation potential[a]		
a. Table V-1		
b. Alternative Table (see text)	98-99	99
Notes: Soils #21 and #59		
2. Important species (Table V-2		60
Notes:		
3. Habitat Uniqueness[a]		
a. Expert opinion		
b. Table V-4		
Commonness	25	
Criticality	10	
Scientific value	10	
Combinations	25	
Sum of above four items	70	70
Notes: Grouse		
4. Total of items 1-3		229
5. Divide total by 3		76.3
6. Adjustments of line 5[b]		76

7. Additional Comments:

---

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 11

1. Reclamation potential[a]		
a. Table V-1		
b. Alternative Table (see text)	99	99
Notes: Soil #59		
2. Important species (Table V-2		60
Notes: Greater Sandhill Crane nearby		
3. Habitat Uniqueness[a]		
a. Expert opinion		
b. Table V-4		
Commonness	25	
Criticality	10	
Scientific value	10	
Combinations	25	
Sum of above four items	70	70
Notes: Elk winter range		
4. Total of items 1-3		229
5. Divide total by 3		76.3
6. Adjustments of line 5[b]		76
7. Additional Comments:		

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

Worksheet for Biological Impact Indicators

Tract No. 12

1. Reclamation potential[a]		
a. Table V-1	99-98	99
b. Alternative Table (see text)		
Notes: Soil mostly #59, some #21		
2. Important species (Table V-2		60
Notes: Greater Sandhill Crane nearby		
3. Habitat Uniqueness[a]		
a. Expert opinion		
b. Table V-4		
Commonness	25	
Criticality	10	
Scientific value	10	
Combinations	25	
Sum of above four items	70	70
Notes: Elk and mule deer winter range; grouse		
4. Total of items 1-3		229
5. Divide total by 3		76.3
6. Adjustments of line 5[b]		76

7. Additional Comments: ______________________

---

[a] Use only one of the two methods, for computing this datum.

[b] Justify any adjustments other than rounding to two significant digits.

E. Socioeconomic Impacts

The overall rating of potential impacts was very similar for the three communities, even though there were differences in the individual components.

Population characteristics of the communities varied widely for readily apparent reasons. The city of Craig has been experiencing a boom period as a result of existing coal mines and the construction of electrical generating facilities. The community grew from 4,025 to 9,991 in 7 years. Steamboat has also been growing rapidly but because of the growth of the ski industry. It is a recreationally oriented town with a very young population. The town of Meeker, on the other hand, is a typical small rural community, but it is expected to grow rapidly in the next few years because of proposed coal and oil shale mining.

Other major differences between the communities are based on the type of economic activity that predominates in each area. Craig's economic base is expanding rapidly in both size and variety. The expansion is directly related to mining and construction. A K-mart, a McDonalds, and a pizza parlor have recently opened in Craig. The city of Steamboat is also booming economically. Most of the growth in this community is related to the ski industry. There are many souvenir and crafts shops as well as restaurants. Meeker, on the other hand, has the economy of a small rural town. It has not been greatly affected by the growth of nearby communities. The town has a two block main street on which most of the stores and restaurants are located.

One of the most critical factors considered was the amount of available housing. Here again, the communities differ. Meeker is expanding the number of available housing units in anticipation of future growth that the town considers inevitable. Both Craig and Steamboat have been growing at such a pace that neither community has been able to meet the increased demand for housing. Furthermore, many of the current residents are not satisfied with the type of housing now available. In most cases, the dissatisfied people are living in apartments or mobile homes and would like a single family dwelling.

The final ratings of these communities are fairly low, mainly because of the situations discussed above. It is important to take into account the reasons for the ratings as well as the overall rating. A summary sheet is included as Table A-9 so that the comparisons between the communities can easily be made. Also, the rating for each tract is shown in Table A-10.

The proximity of potential coal lease sites to these communities was determined. It was assumed that the effects would be greatest in the town closest to the least site.

Table A-9

SOCIOECONOMIC INDICATORS -- SUMMARY SHEET

Element	Meeker/Rio Blanco County	Craig/ Moffet County	Steamboat/ Springs Routt County
1. Population	55	75	35
2. Social Services	55	45	55
3. Present Economic Structure	60	80	80
4. Bond Capacity	50	0	0
5. Private Economic Activity	0	0	20
6. Housing	50	0	0
Total	270	200	190

Divide total by 6 to equalize emphasis with the indicators.

Overall Rating	45	33	32

Table A-10

SOCIOECONOMIC RATING FOR THE COAL LEASE TRACTS

Tract	Rating
1	45
2	45
3	45
4	33
5	33
6	32
7	33
8	33
9	32
10	32
11	33
12	33

SOCIOECONOMIC IMPACT WORKSHEET

City: Craig. County: Moffet.

Worksheet for Part 1: Population.

A. Present Population

Community (impacted) population 9,991 (1978)

Any others within 25 mi radius:

Steamboat	4,028
Meeker	2,779
Hayden	1,362

Points 30

B. Growth Rate

Historical Growth Rate 0.7%/yr or 57% (1970-1978), 0.5%/yr or 5.5% (1960-1970)

Projected Growth Rate 0.3%/yr (1978-1988)

$\frac{\text{number of workers (direct and induced)}}{\text{present population}}$ = 5 % (total growth rate) ÷ 2 (the number of years) = 2.5% projected rate per year.

Points 30

Comments: If there has been a steady growth rate historically, the impact would not be as great as it would in a community which has had stagnant or very rapid growth in the near term. Craig has recently gone through a "boom" period which is very evident in the growth rate compared to historical and projected rates.

C. Age Distribution

Compare:

- present (or most currently available) with national and/or state pyramid (national age distribution is included in the text)
- age characteristics of mine workers and families (the change in age distribution in a boom community is included for reference in the text)

Findings:

___ very similar ___

X similar (when using 1970)

X not similar (when assuming that many more young people are now there.

Points 0

Comments: The Moffet County age profile is not accurate for 1978 due to the more than doubling of the population because of the electrical generating facility and the mines. Many young people have moved into the area.

D. Sex Ratio

Norm: 51% female, 49% male (for the United States)

County ___

Points 15

Comments: Craig also has had an influx of men into the community because of the availability of work. Generally there are more men than women in the community, but how many more is not known.

Total Points for Part 1: 75

Worksheet for Part 2: Social Services

A. Schools

1. a. Current number of students 2,360
   b. Current number of teachers 127
   c. Current number of classrooms used or available 7
   d. Projected enrollment without additional students (obtain from local school district) 2,480
   e. Projected enrollment with additional students (number of new students as a result of the mine = ½ the number of new workers, both direct and induced) 2,730

2. Determine the capacity of schools (using numbers in part 1)

   a. $a \div 25$ = number of classrooms presently used

   b. $e - a$ = total number of new students

   c. $\frac{\text{total number of new students}}{25}$ (average number of students per classroom) = $\frac{\_\_\_\_\_\_}{25}$ = ______ (the number of additional classrooms needed)

   d. Add the number of classrooms presently used to the number of additional classrooms needed. Subtract from this the current number of classrooms available (1.c). A negative number implies inadequate space; a positive number means that space is adequate.

   a. $\frac{2360}{25} = 94$

   b. $2730 - 2360 = 370$

   c. $\frac{370}{25}$ = 15 more classrooms

   d. 94 + 15 = 109 - 74 = 35 more classrooms needed.

Points 0

B. **Hospitals/Doctors**

	community/county	state/nation
Number of doctors/population	1/1,280	(Colo) 1/617
Number of dentists/population	1/2,133	1/1,724
Number of beds in hospital/ population	188/1,000	233/1,000

Points 10

C. **Government Structure**

Number of staff ______
Mayor (yes/no) yes
Planners (yes/no) yes
Engineer (yes/no) yes

Points 25

D. Water/Sewage

1. Water

Average daily water use 450 gpd
Total available water 5,000,000 gpd
- Remaining capacity ______

(water used/person) 450 gpd x (present + additional population)

10,451 = (total water needed) 4,702,950.

(total water capacity) 5,000,000 - (total water needed) 4,702,950

= (additional water needed) (+)2,970,050 (94% of capacity). (positive = adequate; negative = additional capacity necessary)

2. Sewage

Average number of gpd (gallons per day) generated per person:

135 gpd

Capacity of treatment facility 1,200,000

gpd/person 135 x (present and additional population) 10,451

= (total capacity needed) 1,412,933.

(capacity of the facility) 1,200,000 - (total capacity needed)

1,912,933 = +212,933. (positive = adequate; negative = additional capacity necessary)

Points 10

Total Points for Part 2 45

Worksheet for Part 3: Present Economic Structure

A. Employment Distribution (for the whole county)

Major employers	Number of employees	% of Total
- Agriculture	2,475	14.2
- Mining	1,783	10.2
- Retail	3,599	20.5
- Education		
- Government	3,642	20.8
- Services	2,411	13.8
Mine Employment		
- Direct	185	1.0
- Indirect (multiply direct by 2)	275	2.0

Points 20

B. Occupational Distribution

(Determined by using information in Part A. An area with an even distribution of employment would be one in which no particular employer dominates, such as agriculture or construction. The points should be based on the distribution of employment within the town.

Points 20

Comment: Moffet County has a fairly rural distribution of employment which in the past has meant job switching.

C. Unemployment

	Rate	Number	
Nearest community	8 %	335	(12-27-77)
Communities within 25 miles			
Routt	8 %	605	
Rio Blanco	6.2%	340	
	%		

Number of jobs to be created 1,088
(refer to employment distribution)

$$\frac{\text{(number of jobs to be created)}}{\text{(number of unemployed)}} = \frac{1,088}{1,260} = \text{(ratio) less than 1}$$

Points 10

D. Income (Payroll)

Total community income $ 29,334,000

Total mine income $ 2,400,000 % of total 8 %

(for a 1 mtpy mine)

Points 0

Comments:

Total Points for Part 3 50

Worksheet for Part 4: Bonding Capacity

Maximum remaining capacity 772,915

Extent of the requirement for new capital:

- New schoolrooms (yes/no) yes
- Expand water treatment (yes/no) possible
- Expand sewer system (yes/no) possible

Total Points for Part 4 0

Worksheet for Part 5: Private Economic Activity

Size of nearby communities (50-mile radius)

Name	Population
Meeker	2,779
Steamboat Springs	4,028
Hayden	1,362

Comments:

Total Points for Part 5 0

Worksheet for Part 6: Housing

1. Vacancy rate ________
2. Type of housing
    - single family ________
    - multifamily ________
    - mobile homes ________
3. Number of vacant units ________
4. Direct and induced employment (1 mine) 1,088

Employed (4) - number of vacant units (3) = ________ (indication housing need)

Comments: There is currently a housing shortage in Craig due to the rapid increase in population. Also, the cost of housing has jumped substantially. The planning commission and city council are currently working with the coal and electric companies in an attempt to get them to finance housing construction.

Total Points for Part 6 0

City: Steamboat Springs . County: Routt .

Worksheet for Part 1: Population.

A. Present Population

Community (impacted) population 4,028

Any others within 25 mi radius:

Craig	6,677
Hayden	1,362
Oak Creek	756

Points 15

B. Growth Rate

Historical Growth Rate 2.1%/yr (1960-1970)

Projected Growth Rate 5.1%/yr (1970-1980

$\frac{\text{number of workers (direct and induced)}}{\text{present population}}$ = 11 % (total growth rate) ÷ 2 (the number of years) = 5.5% projected rate per year.

Points 20

Comments: If there has been a steady growth rate historically, the impact would not be as great , but in a community which has had stagnant growth or very rapid growth, the impacts are greater and recently experienced.

C. Age Distribution

Compare:

- present (or most currently available) with national and/or state pyramid (national age distribution is included in the text)
- age characteristics of mine workers and families (the change in age distribution in a boom community is included for reference in the text)

Findings:

X very similar community and miners

___ similar

X not similar to national norm

Points 0

Comments: ______________________________

D. Sex Ratio

Norm: 51% female, 49% male (for the United States)
County 48% female, 52% male
Miners more males

Points 0

Comments: ______________________________

Total Points for Part 1: 35

Worksheet for Part 2: Social Services

A. Schools

1. a. Current number of students 1,308
   b. Current number of teachers 70
   c. Current number of classrooms used or available 70
   d. Projected enrollment without additional students (obtain from local school district) ____________
   e. Projected enrollment with additional students (number of new students as a result of the mine = ½ the number of new workers, both direct and induced) 1,750

2. Determine the capacity of schools (using numbers in part 1)

   a. a ÷ 25 = number of classrooms presently used

   b. e − a = total number of new students

   c. $\frac{\text{total number of new students}}{25}$ (average number of students per classroom) = $\frac{\_\_\_\_\_}{25}$ = ________ (the number of additional classrooms needed)

d. Add the number of classrooms presently used to the number of additional classrooms needed. Subtract from this the current number of classrooms available (1.c). A negative number implies inadequate space; a positive number means that space is adequate.

a. 1,308/25 = 52 classrooms

b. 1,750 - 1,308 = 442 new students

c. 442/25 = 18

d. 70 - 52 = 18

Points 20

B. Hospitals/Doctors

	community/county	state/nation
Number of doctors/population		1/611
Number of dentists/population		1/1,500
Number of beds in hospital/ population		20 (total)

Points 10

C. Government Structure

Number of staff 94
Mayor (yes/no) yes
Planners (yes/no) yes
Engineer (yes/no) yes

Points 25

D. Water/Sewage

1. Water

Average daily water use ____________
Total available water ____________
- Remaining capacity ____________

(water used/person)__________ x (present + additional population)

________ = (total water needed)________________.

(total water capacity)____________ - (total water needed)________

= (additional water needed)______________. (positive = adequate; negative = additional capacity necessary)

Comments: There is no data available on water usage because of the lack of water meters; however, according to their public officials, there is very little available water for growth.

2. Sewage

Average number of gpd (gallons per day) generated per person:

____

Capacity of treatment facility 2.08 mgd (expansion is being voted on

Remaining Capacity 2.5 (maximum generated)

gpd/person ________ x (present and additional population) ________

= (total capacity needed) __________.

(capacity of the facility) ________ - (total capacity needed)

__________ = ____________. (positive = adequate; negative = additional capacity necessary)

Points 0

Total Points for Part 2 5

Comments: The sewage treatment facility is already far below the size needed to service the present community.

Worksheet for Part 3: Present Economic Structure

A. Employment Distribution

Major employers	Number of employees	% of Total
- Agriculture	362	14.0
- Mining	175	7.0
- Retail	515	20.0
- Education	224	9.0
- Construction	232	9.0
- Services	391	15.0
Total	2,473	
Mine Employment		
- Direct	185	7.0
- Indirect		
	285	10.0
Total		

Points 20

B. Occupational Distribution

(Determined by using information in Part A. An area with an even distribution of employment would be one in which no particular employer dominates, such as agriculture or construction. The points should be based on the distribution of employment within the town.

Points 20

C. Unemployment

	Rate	Number
Nearest community	%	
Communities within 25 miles		
(County)	8.0%	605
Rio Blanco	6.2%	340
	%	

Number of jobs to be created 462
(refer to employment distribution)

$$\frac{\text{(number of jobs to be created)}}{\text{(number of unemployed)}} = \frac{462}{945} = \text{(ratio) less than 1}$$

Points 40

D. Income (Payroll)

Total community income $30,869
Total mine income $2,400 % of total 7.7%
(for a 1 mtpy mine)

Points 0

Comments:

Total Points for Part 3 80

Worksheet for Part 4: Bonding Capacity

Maximum remaining capacity 236,631
Extent of the requirement for new capital:
- New schoolrooms (yes/no) yes
- Expand water treatment (yes/no) yes
- Expand sewer system (yes/no) yes

Comments: People have historically not passed bonds of any kind!

Total Points for Part 4 0

Worksheet for Part 5: Private Economic Activity

Size of nearby communities (50-mile radius)

Name	Population
Craig	9,991
Hayden	1,362
Oak Creek	756

Comments: In the case of Steamboat, which is a very service-oriented town, points were given even though it did not meet the criteria

Total Points for Part 5 20

Worksheet for Part 6: Housing

1.	Vacancy rate	4%
2.	Type of housing	
	- single family	770
	- multifamily	507
	- mobile homes	237
3.	Number of vacant units	1,514
4.	Direct and induced employment (1 mine)	462

Employed (4) - number of vacant units (3) = -387 (indication housing need)

Comments: Steamboat already has a housing deficit particularly during the winter (ski season). Also, a lot of the housing is too expensive for many of the people who need it. Steamboat is expecting to continue to grow, which would also mean more housing.

Total Points for Part 6 0

City: Meeker. County: Rio Blanco.

Worksheet for Part 1: Population.

A. Present Population

Community (impacted) population 2,779

Any others within 25 mi radius:

Craig	9,991
Hayden	1,362

Points 15

B. Growth Rate

Historical Growth Rate 15%/7 yr = 2.1%/yr (1970-1977)

Projected Growth Rate (1980) 6,200; 23%/yr (hard to believe)

$$\frac{\text{number of workers (direct and induced)}}{\text{present population}} = \underline{24}\ \%$$ (total growth rate) ÷ 2 (the number of years) = 12 % projected rate per year.

Points 0

Comments:

C. Age Distribution

Compare:
- present (or most currently available) with national and/or state pyramid (national age distribution is included in the text)
- age characteristics of mine workers and families (the change in age distribution in a boom community is included for reference in the text)

Findings:
X very similar (to national)
___ similar
___ not similar

Points 25

Comments: The population is slightly older than the average U.S. population, which means that an influx of workers would tend to unbalance the community.

D. Sex Ratio

Norm: 51% female, 49% male (for the United States)
County (Meeker) 51% female, 49% male
Miners tend to be more males

Points 15

Comments: ______

Total Points for Part 1: 55

A. Schools

1. a. Current number of students 754
   b. Current number of teachers 30
   c. Current number of classrooms used or available 51
   d. Projected enrollment without additional students (obtain from local school district) 771
   e. Projected enrollment witn additional students (number of new students as a result of the mine = ½ the number of new workers, both direct and induced) 1,030

2. Determine the capacity of schools (using numbers in part 1)

   a. a ÷ 25 - number of classrooms presently used

   b. e - a = total number of new students

   c. $\frac{\text{total number of new students}}{25} = \frac{\_\_\_\_\_\_}{25} = \_\_\_\_\_\_$ (the number of additional classrooms needed)

   (average number of students per classroom)

d. Add the number of classrooms presently used to the number of additional classrooms needed. Subtract from this the current number of classrooms available (1.c). A negative number implies inadequate space; a positive number means that space is adequate.

a. 754/25 = 30

b. 1,030 - 754 = 276

c. 274/25 = 11 classrooms

d. 30 + 11 = 41 - 50 = 9 extra classrooms or 225 spaces.

Comments: Space is not evenly distributed: the elementary school is currently overcrowded and the junior high school is empty. They plan to move some of the K-6 to this school.

Points

20

B. Hospitals/Doctors

	community/county	state/nation
Number of doctors/population	1/1,221 (4)	1/617
Number of dentists/population	1/977 (5)	1/1,724
Number of beds in hospital/ population	1/139 (20)	1/233

Points

10

C. Government Structure

Number of staff ______
Mayor (yes/no) yes
Planners (yes/no) yes
Engineer (yes/no) no

Points

25

Comment: The town of Meeker was given a high rating because it has a large planning staff (2 persons) for a community of this size.

D. Water/Sewage

1. Water

Average daily water use 822 gpd/person
Total available water 1,600,000
- Remaining capacity

(water used/person) 822 gpd x (present + additional population)

2,308 = (total water needed) 1,897,176 .
(only workers, not families)

(total water capacity) 1,600,000 - (total water needed) 1,897,176

= (additional water needed) -297,179 gpd . (positive = adequate;
negative = additional
capacity necessary)

Comments: Even without the families the water supply is inadequate.

2. Sewage

Average number of gpd (gallons per day) generated per person:

97 gpd

Capacity of treatment facility 200,000

gpd/person 97 x (present and additional population) 2,308

= (total capacity needed) 223,876 .

(capacity of the facility) 200,000 - (total capacity needed)

223,876 = -23,876 . (positive = adequate;
negative = additional
capacity necessary)

Points 0

Total Points for Part 2 55

Worksheet for Part 3: Present Economic Structure

A. Employment Distribution (Rio Blanco County)

Major employers	Number of employees	% of Total
- Agriculture	294	15.0
- Mining	280	14.0
- Retail	219	11.0
- Education	217	11.0
- Government		
- Services	346	18.0
Mine Employment		
- Direct	185	10
- Indirect		
	275	14

Points 10

Comments: These employment distributions reflect the oil shale activity near Rangly. Most of this is not directly affecting Meeker.

B. Occupational Distribution

(Determined by using information in Part A. An area with an even distribution of employment would be one in which no particular employer dominates, such as agriculture or construction. The points should be based on the distribution of employment within the town.

Points 20

C. Unemployment

	Rate	Number
Nearest community	3.0 %	52
Communities within 25 miles		
Routt County	7.9 %	605
Moffet County	6.0 %	335
	%	

Number of jobs to be created 460
(refer to employment distribution)

$$\frac{\text{(number of jobs to be created)}}{\text{(number of unemployed)}} = \frac{460}{992} = \text{(ratio) less than 1}$$

Points 20

D. Income (Payroll)

Total community income $23,653,000 (County)
Total mine income $2.4 million % of total 10 %
(for a 1 mtpy mine)

Points 10

Comments: The income information is for the whole county, so it is safe to assume that it would be a larger percentage of the income in Meeker alone.

Total Points for Part 3 60

Worksheet for Part 4: Bonding Capacity

Maximum remaining capacity 425,074
Extent of the requirement for new capital:
- New schoolrooms (yes/no) yes
- Expand water treatment (yes/no) yes
- Expand sewer system (yes/no) yes

Total Points for Part 4 50

Comments: There is now a lot of government funding available to assist towns such as Meeker.

Worksheet for Part 5: Private Economic Activity

Size of nearby communities (50-mile radius)

Name	Population
Craig	9,991
Rangly	1,785
Hayden	1,362
Steamboat Springs	4,028

Comments: Many of the roads become very difficult to use during the winter.

Total Points for Part 5 0

Worksheet for Part 6: Housing

1. Vacancy rate	19.1%	
2. Type of housing	1,810	(total)
- single family	1,630	
- multifamily	111	
- mobile homes	79	
3. Number of vacant units	349	
4. Direct and induced employment (1 mine)	462	

Employed (4) - number of vacant units (3) = 53 (indication housing need)

Comments: A large percentage of Rio Blanco County lacks water, sewer service, or electricity, which means that houses are below grade. These houses have been included in the data.

Total Points for Part 6 50

F. Legal/Institutional Impact Indicator

The overall legal/institutional score was obtained by adding the alternative land use score for each tract to the surface-ownership/mineral-ownership indicator for that tract. These scores, shown in Table A-11, revealed that Tract 4 is most favored and Tract 8 is least favored.

Scores for each indicator are developed in the manner described in the text which follows.

1. Alternative Land Use Element

This element was developed on the basis of land use information obtained from the BLM's Regional EIS for Northwest Colorado Coal. Each category of alternative use was given a value based on the analyst's judgment. A weighting factor was applied to these values to give a score for each tract (see the Worksheets). The results are shown in Table A-12.

Table A-11

SUMMARY TABLE FOR LEGAL/INSTITUTIONAL IMPACT INDICATOR

Tract	Alternative Use Element	Ownership Element	Overall Score	Ranking
1	38	24	62	2
2	36	25	61	3
3	40	20	60	4
4	42	24	66	1
5	36	18	54	9
6	38	19	57	7
7	34	17	51	10
8	24	19	43	12
9	38	22	60	5
10	40	15	55	8
11	32	19	51	11
12	38	22	60	6

Table A-12

ALTERNATIVE LAND USE ELEMENT SUMMARY SHEET

Tract	Score
1	38
2	36
3	40
4	42
5	36
6	38
7	34
8	24
9	38
10	40
11	32
12	38

2. Surface-Ownership/Mineral-Ownership Element

BLM Surface Minerals management Quads (Color Quads) were used for development of this element. The survey Color Quads were current as of October 1975. These maps showed land and mineral ownership status, but they did not show the status of outstanding federal permits on federally controlled surface areas, or whether permission has been obtained from privately owned surface estates for the mining of federal coal beneath them. This information can be obtained from the BLM and the Department of the Interior, but it not readily available and therefore was not used in this test case.

For purposes of testing the methodology, it was assumed that no surface leases or permits were in effect on federal land; it was also assumed that permission had been obtained from surface owners in the case of private surface ownership of federal coal. For privately owned surface and mineral estates, it was assumed that permission had not been obtained from the owners.

Scores are developed for each tract, taking into consideration the fraction of the tract represented by each ownership category (i.e., the "weighting factor"). In this manner, an ownership element is developed for each tract (see the Worksheets). The cumulative results for this impact indicator are shown in Table A-13.

Table A-13

SURFACE-OWNERSHIP/MINERAL-OWNERSHIP ELEMENT SUMMARY SHEET

Tract	Score
1	24
2	25
3	20
4	24
5	18
6	19
7	17
8	19
9	22
10	15
11	19
12	22

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 1

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	Irrigated cropland along Sulphur Creek; non-irrigated cropland eastern sector	30	6
Ranching	Rangeland: cattle and sheep (summer)	20	4
Forestry	Five percent forested	40	8
Wilderness Protection/ Recreation	No designation	50	10
Archaeological/ Historical Importance	No designation	50	10

Alternative Land Use Score 38

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 2

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	Some irrigated cropland	40	8
Ranching	Rangeland: cattle and sheep (summer)	20	4
Forestry	Fifteen percent woodlands	20	4
Wilderness Protection/ Recreation	No designation	50	10
Archaeological/ Historical Importance	No designation	50	10

Alternative Land Use Score 36

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 3

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	Some irrigated agriculture on Wilson Creek	40	8
Ranching	Rangeland: cattle and sheep (summer)	20	4
Forestry	No woodlands	50	10
Wilderness Protection/ Recreation	No designation	50	10
Archaeological/ Historical Importance	Immediately adjacent to area of medium importance	40	8

Alternative Land Use Score 40

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 4

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	Some irrigated agriculture on Collon Creek	40	8
Ranching	Rangeland: cattle and sheep (summer)	20	4
Forestry	No woodlands	50	10
Wilderness Protection/ Recreation	No designation	50	10
Archaeological/ Historical Importance	No designation	50	10

Alternative Land Use Score 42

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 5

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	No designated cropland	50	10
Ranching	Rangeland: cattle and sheep (summer)	20	4
Forestry	Twenty percent woodlands	20	4
Wilderness Protection/ Recreation	No designation	50	10
Archaeological/ Historical Importance	Located between two areas of medium importance	40	8

Alternative Land Use Score 36

[redacted]

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 6

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	Some non-irrigated cropland	40	8
Ranching	Rangeland: cattle (spring/summer/ fall); sheep (spring/fall)	20	4
Forestry	No woodlands	50	10
Wilderness Protection/ Recreation	Immediately adjacent to recreation area	30	6
Archaeological/ Historical Importance	No designation	50	10
	Alternative Land Use Score		38

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 7

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	Fifteen percent non-irrigated cropland	30	6
Ranching	Rangeland: cattle and sheep (summer)	20	4
Forestry	No woodlands	50	10
Wilderness Protection/ Recreation	No designation	50	10
Archaeological/ Historical Importance	Medium Importance (one site per township)	20	4

Alternative Land Use Score 34

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 8

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	Contains some irrigated cropland near Yampa River	20	4
Ranching	Rangeland: cattle (spring/summer/ fall); sheep (spring/fall)	20	4
Forestry	Contains some woodlands	20	4
Wilderness Protection/ Recreation	No designation; primitive natural features along the Yampa River	50	10
Archaeological/ Historical Importance	High importance (approximately one site per section)	10	2
		Alternative Land Use Score	24

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 9

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	No designated cropland	50	10
Ranching	Rangeland: cattle and sheep (summer)	20	4
Forestry	Not forested (near White River National Forest)	50	10
Wilderness Protection/ Recreation	No designation	50	10
Archaeological/ Historical Importance	Medium archaeological importance (White River Indian Agency Trail of 1868 cuts across the tract)	20	4

Alternative Land Use Score 38

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 10

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	Some cropland west of Dry Creek	40	8
Ranching	Rangeland: cattle and sheep (summer)	20	4
Forestry	No woodlands	50	10
Wilderness Protection/ Recreation	No designation	50	10
Archaeological/ Historical Importance	Immediately adjacent to area of medium archaeological/historical importance	40	8

Alternative Land Use Score 40

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 11

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	Considerable non-irrigated agriculture and some irrigated agriculture	20	4
Ranching	Rangeland: cattle and sheep (summer)	20	4
Forestry	No woodlands	50	10
Wilderness Protection/ Recreation	No designation	50	10
Archaeological/ Historical Importance	Medium importance	20	4

Alternative Land Use Score 32

WORKSHEET FOR ALTERNATIVE LAND USE ELEMENT

Tract 12

	Uses	Assigned Value	Weighted Value (x 0.20)
Agriculture	No designated cropland	50	10
Ranching	Rangeland: cattle (spring/summer/ fall); sheep (spring/fall)	20	4
Forestry	Small woodland in western-most area of tract, minimal conflict	50	10
Wilderness Protection/ Recreation	No designation	50	10
Archaeological/ Historical Importance	Medium archaeological/historical importance (approximately 1 site per township	20	4

Alternative Land Use Score 38

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 1

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.18	=	9
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.66	=	13
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.16	=	2

Ownership Element Score 24

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[a] Includes state-owned land.

[b] Includes state-owned coal.

[redacted]

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 2

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.16	=	8
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.78	=	16
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.05	=	1

Ownership Element Score 25

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[a] Includes state-owned land.

[b] Includes state-owned coal.

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 3

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.03	=	2
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.79	=	16
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.18	=	2

Ownership Element Score 20

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[a] Includes state-owned land.

[b] Includes state-owned coal.

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 4

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.18	=	9
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.67	=	13
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.15	=	2

Ownership Element Score 24

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[a] Includes state-owned land.

[b] Includes state-owned coal.

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 5

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.02	=	1
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.77	=	15
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.21	=	2

Ownership Element Score 18

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[a] Includes state-owned land.

[b] Includes state-owned coal.

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 6

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.01	=	1
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.80	=	16
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.19	=	2

Ownership Element Score 19

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[a] Includes state-owned land.

[b] Includes state-owned coal.

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 7

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.00	=	0
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.77	=	15
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.23	=	2

Ownership Element Score 17

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[a] Includes state-owned land.

[b] Includes state-owned coal.

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 8

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.25[a]	=	12
Private[b] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.27	=	5
Private[b] Surface Ownership/ Private Coal Ownership[c]	Surface owners have not yet given permission	10	x	0.23	=	2
	Ownership Element Score					19

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[a] Actual Factor is 0.5; however, one-half of land is in "ownership reserved" category.

[b] Includes state-owned land.

[c] Includes state-owned coal.

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 9

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.07	=	4
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.90	=	18
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.03	=	0

Ownership Element Score 22

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[a] Includes state-owned land.

[b] Includes state-owned coal.

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 10

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.02	=	1
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.40	=	8
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.58	=	6

Ownership Element Score 15

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[a] Includes state-owned land.

[b] Includes state-owned coal.

[redacted]

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 11

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.02	=	1
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.78	=	16
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.20	=	2

Ownership Element Score 19

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[a] Includes state-owned land.

[b] Includes state-owned coal.

WORKSHEET FOR OWNERSHIP ELEMENT

Tract 12

Ownership	Description of Leases/Permits	Assigned Value		Weighting Factor (Decimel Fraction of Tract Area)		Weighted Value
Federal Surface Ownership/ Federal Coal Ownership	No surface leases or permits are in effect	50	x	0.08	=	4
Private[a] Surface Ownership/ Federal Coal Ownership	Secretary has obtained permission from owners of surface estates	20	x	0.90	=	18
Private[a] Surface Ownership/ Private Coal Ownership[b]	Surface owners have not yet given permission	10	x	0.02	=	0

Ownership Element Score 22

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[a] Includes state-owned land.

[b] Includes state-owned coal.

Appendix B

LEGAL AND REGULATORY FRAMEWORK*

I. INTRODUCTION

A list of pertinent federal laws and regulations has been included as reference for users of the methodology. Also, a short discussion of the role of state and local laws has been included to provide some examples of the way in which the problems related to coal mining are being dealt with at these levels of government.

II. FEDERAL LAWS AND REGULATIONS

A. General

The two laws that provide the basic authorities for leasing and management of federal minerals, including coal, are the Mineral Leasing Act (41 Stat. 427, as amended; 30 USC 181 et seq.) and the Mineral Leasing Act for Acquired Lands (61 Stat. 913; 30 USC 351-359).

Passage of the Federal Land Policy and Management Act of 1976, P.L. 94-579 (90 Stat. 2743; 43 USC 1701-1771) has given the Bureau of Land Management (BLM) a mandate to retain public lands for multiple-use management. In addition, P.L. 94-579 has given BLM the authority to carry out comprehensive land use planning to be used in decision making, has abolished or consolidated a number of old public land laws, and authorizes BLM to promulgate regulations and policy governing all aspects of public land management. Basically, the law consolidates existing authorities in one document and ensures that the public lands remain open for location of mining claims, for public hunting, fishing, camping, and other outdoor recreation, and for the development of natural resources.

With respect to coal leasing and development, these laws are implemented by BLM and the USGS under the regulations described below.

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*Edited and adapted from Department of the Interior, Bureau of Land Management, Addendum to Final Environmental Impact Statement, Northwest Colorado Coal.

Title 43 CFR 3041 sets forth the regulations governing leasing, permitting, and licensing procedures; reclamations standards; use of surface; bond requirements; and reports relating to leases, permits, and licenses issued by the BLM related to federal coal deposits located on U.S. public and acquired lands and reserved deposits underlying lands whose surfaces are privately owned. In effect, the regulations allow BLM to exercise its environmental protection responsibilities while it ensures orderly development of the federal coal deposits. The regulations seek to ensure that adequate measures are taken during exploration or mining of the federal coal to avoid, minimize, or correct damages to the environment (land, water, and air), and to avoid, minimize, or correct hazards to public health and safety.

Title 43 CFR 3500 provides procedures for leasing and subsequent management of deposits of federal coal (and other minerals).

Title 43 CFR 2800 establishes procedures for issuing rights-of-way to private individuals and companies on public lands. These regulations provide the backing for identifying and protecting environmental resources that could be affected by right-of-way construction for coal-related projects.

Title 30 CFR 211 governs operations for discovery, testing, development, mining, and preparation of federal coal under leases, licenses, and permits pursuant to 43 CFE 3500. The purposes of the regulations in Part 211 are to promote orderly and efficient operations and production practices without waste or avoidable loss of coal or other mineral-bearing formation; to encourage maximum recovery and use of coal resources; to promote operating practices that will avoid, minimize, or correct damage to the environment, including land, water, and air, and avoid, minimize, or correct hazards to public health and safety; and to obtain a proper record of all coal produced.

The Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87) regulates surface mining and surface effects of underground mining of all coal deposits and is implemented by the newly established Office of Surface Mining under the regulations in Title 30 CFR 7000.* The Act and regulations provide for environmental performance standards for surface coal mining and reclamation operations; inspection and enforcement procedures, including the assessment of civil penalties; requirements and approval procedures for state programs; requirements for surface coal mining and reclamation operations on public lands; procedures for state and federal designation of areas unsuitable for surface or underground coal mining operations; requirements and procedures for approval of state mining permits; and requirements for posting, release, and forfeiture of performance bonds.

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*Regulations referred to as being issued under the Surface Mining Control and Reclamation Act of 1977 are interim regulations. At the present time, the Office of Surface Mining is drafting and circulating for comment proposed permanent regulations.

B. Geologic Setting

1. Mining on Slopes Greater Than 20 Percent

Title 30 CFR part 716.2 deals with mining on slopes greater than 20% and states that spoils shall not be placed or allowed to remain on the downslope. The highwall shall be completely covered with spoil, and the affected area shall be graded to the approximate original contour, as provided in 30 CFR 715.14.

2. Reclamation

a. Restoration to Original Contour. Title 30 CFR part 715.14 states that to achieve the approximate original contour, the permittee shall transport, backfill, compact (where advisable to ensure stability or to prevent leaching of toxic materials), and grade all spoil material to eliminate all highwalls, spoil piles, and depressions. Title 30 CFR part 715.13 (a) states that ". . . all disturbed areas shall be restored in a timely manner (1) to conditions that are capable of supporting the uses which they were capable of supporting before any mining or (2) to higher or better uses . . ."

b. Mountain Top Removal. Mountain top removal is covered in 30 CFR, Parts 715.14 (c) and 716.3. These regulations state in part that if an operator removes entire coal seam(s) in the upper part of a mountain, ridge, or hill, the area need not be restored to approximate original contour, but that all highwalls, spoil piles, and major depressions shall be eliminated. The final graded top plateau slopes shall be less than 20%.

Regulations contained in 30 CFR 211 include those concerned with maximum resource recovery and minimum damage to remaining mineral resources (211.4 (b and c)), prevention of damage to significant scientific values (211.4(d)(9)), subsidence (211.31(a and c)), hazardous conditions (211.4(d)(7)), returning land to its approximate original contour (211.40(a)(2)), and stabilization of slopes to avoid landslides (211.40(a)(3)). Compliance would be the responsibility of the Area Mining Supervisor, USGS, in consultation with the District Manager, BLM.

C. Water Resources

The rules and regulations shown in Table B-1 affect water resources and are arranged in order of importance.

Table B-1

SUMMARY OF IMPORTANT WATER RESOURCES RULES AND REGULATIONS

Rules and Regulations	Authority	Applicability
30 CFR 700 (Federal Register, vol. 42, no. 239, December 13, 1977)	Surface Mining Reclamation and Enforcement Act Public law 95-87 August 3, 1977	Federal, state, and fee coal
30 CFR 211 (Federal Register, vol. 41, no. 96, May 17, 1976	Pursuant to regulations in 43 CFR Group 3500 and the Alaska coal Leasing Act of October 20, 1914, as amended (38 Stat. 741; 48 U.S.C. 432-445)	Federal coal
43 CFR 3041 (Federal Register, vol. 41, no. 96 May 17, 1976)	Mineral leasing Act of February 25, 1920, as amended (30 U.S.C. 181-287) and the Mineral Leasing Act for Acquired Lands (30 U.S.C. 351-359)	Federal coal leases

In addition to the rules and regulations in Table B-1, all waters are subject to provisions of the Federal Water Pollution Control Act (FWPCA), as amended in 1972 (P.L. 92-500).

1. General

a. Hydrologic balance. The permittee must plan and conduct surface and underground coal mining and reclamation operations to minimize disturbance of the prevailing hydrologic balance to prevent long-term adverse changes that could result both on and off site (30 CFR 715.17 and 717.17).

The operator must take such actions as may be needed to minimize, control, or prevent (1) soil erosion; (2) pollution of surface or ground water; and (3) serious diminution of the normal flow of water (30 CFR 211.4 (d)).

Applications to BLM for a coal lease, permit, or license must contain a brief description of the proposed measures to be taken to control or prevent soil erosion and pollution of surface and groundwater (43 CFR 3041.1-2 (b)(2)(v)).

b. Water rights. The permittee must replace the water supply of an owner of interest in real property who obtains all or part of his supply of water for domestic, agricultural, industrial, or other legitimate use from an underground or surface source where such supply hs been affected by contamination, diminution, or interruption proximately resulting from surface or underground coal mine operations by the permittee (30 CFR 715.17 (i) and 171.17 (i)).

c. Alluvial valley floors. Coal mining operations in and adjacent to alluvial valley floors must be planned and conducted so as to preserve the essential hydrologic functions of these valley floors. Mining must not interrupt, discontinue, or preclude farming on alluvial valley floors and shall not materially damage the quantity or quality of surface water or ground water that supplies these areas unless their premining use was undeveloped rangeland or unless the area of alluvial valley floor is small and provides negligible support for production from one or more farms. This exclusion does not apply to mines in production or having permits to mine on alluvial valley floors before August 3, 1977 (30 CFR 715.17 (j)).

d. Valley floors. No land within 100 feet of an intermittent or perennial stream shall be disturbed by surface or underground coal mnining and reclamation operations unless specifically authorized by the regulatory authority (30 CFR 715.15 (d)(3) and 717.17 (d)).

The quality, quantity, and flow, including depth of flow, of upstream and downstream surface and ground water resources of those valley floors that provide water sources that support significant vegetation or supply significant quantities of water for other purposes shall be protected (43 CFR 3041.2-2 (f)(7)(iv)).

e. Diversion of water. Surface or ground waters shall not be discharged or diverted into underground mine workings (30 CFR 715.17 (h)).

f. Inspections. The Mining Supervisor must inspect coal mining operations to determine compliance with surface and ground water management and pollution control measures required by applicable leases, permits, or licenses and approved plans, and promptly notify appropriate representatives of other federal and state agencies in the event of any noncompliance (30 CFR 211.3 (11)).

2. Ground Water

a. Protection of the hydrologic system. Surface and underground coal mining operations must be conducted so as to minimize adverse effects on ground water flow and quality, both on site and off site. The permittee must monitor to ensure that operations conform to this requirement (30 CFR 715.17 and 717.17).

b. Restoration of recharge capacity. Reclaimed areas must be restored to approximate premining recharge capacity to support approved postmining land use and minimize disturbances to the prevailing hydrologic balance, both on site and off site. The permittee must monitor to ensure conformance with this requirement (30 CFR 715.17 (h)(1)).

c. Leaching of toxic pollutants. Backfilled materials must be selectively placed and compacted wherever necessary to prevent leaching to toxic pollutants into surface waters (30 CFR 715.14 (j)(2), 717.14 (a), 211.40 (a)(2), (8); 43 CFR 3041.2-2 (f)(2)).

d. Mixing of groundwaters. Pollution or mixing of ground waters of significantly different quality shall be prevented by casing, sealing, or otherwise managing drill holes, wells, auger holes, shafts, etcl (30 CFR 715.17 (g)(5), 211.3(9), and 43 CFR 3041.2-2 (f)(7)(i)).

e. Disposal of wastes. Waste materials from conversion facilities (power plants) and municipal wastes must be buried so as not to adversely affect water quality (30 CFR 715.14 (j)(3)).

f. Preblasting survey. Personnel approved by the regulatory authority shall conduct a preblasting survey to determine the condition of all wells or other water systems used for human, animal, or agricultural purposes and the quantity and quality of the water. A written report shall include recommendations of any special conditions or proposed adjustments to the blasting procedures to prevent damage to identified wells or water systems (30 CFR 715.19 (b)(2)).

g. Blasting. Blasting shall be conducted so as to prevent any change in the availability of ground or surface waters outside the permit area (30 CFR 715.19 (e)(2)(i)).

h. Use of wells by others. Upon receipt of a written request from the surface owner or the appropriate authorized officer, the Mining Supervisor may approve the transfer of an exploratory well for further use as a water well, subject to any applicable state law requirements. Approval of the well transfer will be accompanied by a corresponding transfer of responsibility for any liability for damage and eventual plugging (30 CFR 211.21 (c)).

i. Monitoring. Groundwater levels, infiltration rates, subsurface flow and storage characteristics, and the quality of groundwater shall be monitored in a manner approved by the regulatory authority to determine the effects of surface and underground coal mining and reclamation operations on the recharge capacity of reclaimed lands and on the quantity and quality of water in groundwater systems on site and in associated off-site areas (30 CFR 715.17 (h)(3) and 717.17 (h)(2)).

j. Permanent abandonment. Before permanent abandonment of coal explorations or mining operations, all openings and excavations, including water-discharge points, shall be closed or backfilled, or otherwise permanently dealt with in accordance with sound engineering practices and according to the approval plan (30 CFR 211.41 (c)).

3. Surface Water

a. Stream channels. Changes in the location of surface water drainage channels must be minimized so as not to adversely affect post-mining land use.

b. Stream channel diversions. Diversions of perennial and intermittent streams must be approved by the regulatory authority and must be in compliance with all federal and state statutes and regulations. New channels must maintain average stream gradients and remain stable to the extent possible using the best technology currently available (30 CFR 715.17 (d)(1)(i) and 717.17 (d)).

Channel and flood-plain configurations must be adequate to safely pass peak runoff from a precipitation event having a 10-year recurrence interval for temporary diversions and a 100-year recurrence interval (or for larger storms if required by the regulatory authority) for permanent diversions (30 CFR 715.17 (d)(1)(ii) and 717.17 (e)).

c. Diversion structures. All temporary diversion structures must be removed and the affected land reclaimed. When such structures are removed, all downstream water-treatment structures protected by these temporary diversion structures must be modified or removed to prevent failure (30 CFR 715.17 (d)(2) and 717.17 (d)).

d. Postmining use of land. The proposed postmining land use must not present actual or probable threat of water flow diminution or pollution (30 CFR 715.13 (d)(6)).

Proposals to change premining land uses of range, fish, and wildlife habitat, forest land, hayland, or pasture to a postmining cropland use, where the cropland would require continuous maintenance to be practicable or to comply with applicable federal, state, and local laws, shall be reviewed by the regulatory authority to assure that sufficient water is available and committed to maintain crop production (30 CFR 715.13 (d)(9)(ii)).

e. Treatment of runoff. All water discharged from disturbed areas that violates federal or state laws or regulations must be treated by adequate facilities except for runoff from a 10-year 24-hour precipitation event or larger storm (30 CFR 715.17 (a)(2)).

f. Noxious substances. The operator must treat or dispose of all rubbish and noxious substances in a manner designed to minimize, control, or prevent water pollution (43 CFR 3041.2-2 (f)(8)).

g. Acid and toxic materials. Drainage emanating from acid-forming or toxic-forming mine waste materials and spoils placed on the land surface shall be avoided by burying or otherwise treating all toxic or harmful materials where necessary and by preventing water from contacting these materials (30 CFR 715.15 (g), 717.17 (g), and 211.40 (a)(7); 43 CFR 3041.2-2 (f)(7)(i)).

All exposed coal seams and any acid- or toxic-forming materials shall not be buried or stored near drainage courses or where they pose a threat of water pollution (30 CFR 715.14 (j)(1)).

h. Pollution control. Backfilled materials must be selectively placed and compacted wherever necessary to prevent leaching of toxic forming materials into surface or subsurface waters (30 CFR 715.14 (j)(2)).

Water pollution shall be minimized by using treatment methods where necessary such as stabilizing disturbed areas through grading, diverting runoff, achieving quick growing stands of temporary vegetation, lining drainage channels with rock or vegetations, mulching, selectively placing waste materials in backfilled areas, and using water-treatment facilities (30 CFR 715.17).

i. Water quality standards and effluent limitations. Discharges from areas disturbed by surface and underground coal mining operations and reclamation activities conducted thereon must meet all applicable federal and state regulations and at a minimum the numerical effluent limitations described in Table B-2.

Discharge from a precipitation event larger than 10-year 24-hour recurrence interval is not subject to the above effluent limitations (30 CFR 715.17 (1) and 717.17 (a)).

Table B-2

EFFLUENT LIMITATIONS (mg/l)

Effluent Characteristics	Maximum Allowable	Average of Daily Values for 30 Consecutive Discharge Days
Iron, total	7.0	3.5
Manganese, total	4.0	2.0
Total suspended solids	45.0	30.0

j. Dams constructed of or impounding waste material. No waste material shall be used in or impounded by existing or new dams without the approval of the regulatory authority. The permitte must design, locate, construct, operate, maintain, modify, and abandon or remove all dams constructed of waste materials in accordance with the requirements set forth in 30 CRF 715.18 (30 CFR 715.18 (a) and 717.18 (a)).

k. Permanent impoundments. The permittee may construct permanent water impoundments on mining sites as a part of reclamation activities only when they are authorized by the regulatory authority and are adequately demonstrated to be in compliance with regulations governing the postmining use of the land and backfilling and grading in addition to the following requirements:

- o The size of the impoundment is adequate for its intended purposes.
- o Dam construction is designed to achieve necessary stability with an adequate margin of safety.
- o The quality of the impounded water will be suitable on a permanent basis for its intended use and discharges from the impoundment will not degrade the quality of receiving waters below the water quality standards established pursuant to applicable federal and state laws.
- o The level of water will be reasonably stable.
- o Final grading will comply with provisions of 30 CFR 715.14 and will provide adequate safety and access for proposed water users.

- The impoundments will not result in the diminution of water used by adjacent landowners for agricultural, industrial, recreational, or domestic uses (30 CFR 715.17 (k), 211.40 (a)(5), and 43 CFR 3041.2-2 (f)(5)).

l. Discharge permit. If discharge occurs, the operator must obtain a national Pollutant Discharge Elimination System (NPDES) permit.

m. Monitoring. The permittee must monitor all discharge from the disturbed area and from any underground operations. The monitoring program must provide adequate data to describe the likely daily and seasonal variations in discharges in terms of flow, pH, total iron, total manganese, total suspended solids, and if requested by the regulatory agency, any other parameter characteristic of the discharge; and determine normal and abnormal variations in concentrations. The program also must provide for analytical quality control including standards methods of analysis such as those specified in 40 CFR 136 (30 CFR 715.17 (b)(1), 171 (b)(1), and 211.4 (e)).

n. Water quality violations. Should any violations of permit conditions occur, the regulatory authority must be notified immediately after receipt of analytical results by the permittee (30 CFR 715.17 (b)(1)(v) and 717.17 (b)(1)(v)).

o. Monitoring discharge from reclaimed areas. The permittee must monitor surface water quality and flow from disturbed areas that have been regraded and stabilized to demonstrate that the quality and quantity of runoff without treatment will minimize disturbance to the prevailing hydrologic balance and permit the approved postmining land use. These data provide a basis for approval by the regulatory authority for removal of water quality or flow control systems and for determining when reclamation requirements are met (30 CFR 715.17 (b)(2)).

p. Monitoring equipment. Equipment, structures, and other measures used to monitor runoff must be properly installed, maintained, and operated and must be removed when no longer required (30 CFR 715.17 (b)(3)).

D. Erosion Control

1. Sediment Control Measures, General

Appropriate sediment control measures must be designed, constructed, and maintained to prevent additional sediment from entering streams outside the permit area to the extent possible using the best technology currently available (30 CFR 715.17 (e), 717.17 (e), 211.40 (a)(3); 43 CFR 3041.2-2 (f)(7)(ii)).

2. Topsoil Handling

Topsoil must be segregated, and if not used immediately, must be stockpiled and protected from wind and water erosion (30 CFR 715.16, 717.20 (a), 211.40 (a)(4); 43 CFR 3041.2-2 (f)(4)).

3. Slope Stability

Backfilled materials must be selectively placed and compacted wherever necessary to ensure their postmining stability (30 CFR 715.14 (j)(2) and 717.14 (a)).

Highwalls must be reduced to slopes not exceeding 50% or to such lesser slopes as the regulatory authority may specify (30 CFR 715.14 (g)(2)).

Highwalls must be eliminated in areas of adequate overburden by backfilling with suitable spoil and waste materials (30 CFR 715.14 (h)(5)).

Final graded slopes must not exceed approximate premining slopes. Lesser slopes mav be specified by the regulatory authority (30 CFR 715.14 (b)).

Cut and fill terraces may be used on steep slopes to conserve soil moisture, ensure stability, and control erosion on final graded slopes (30 CFR 715.14 (b)(2)).

4. Stability of Spoils Placed Outside Mined Areas

Such spoils must be placed on the most moderately sloping and naturally stable areas available. Fill materials must be placed on or above a natural terrace, bench, or berm, if such placement provides additional stability and prevents mass movement (30 CFR 715.15 (a)(2)).

Fills on slopes higher than 36% or on lesser slopes designated by the regulatory authority shall require keyway cuts to stable bedrock or rock toe buttresses to stabilize the fills (30 CFR 715.15 (a)(4)).

A system of underdrains must be installed along buried natural drainage systems to facilitate drainage and prevent saturation and mass movement (30 CFR 715.15 (b)(6)).

Such spoils must be transported and placed in a controlled manner and concurrently compacted as specified by the regulatory authority to ensure mass stability (30 CFR 7151.5 (b)(7)).

Terraces as specified must be constructed to stabilize the face of the fill (30 CFR 715.15 (b)(8)).

The tops of the fill and each terrace shall be graded no steeper than 5% and shall drain surface runoff to the sides of the fill where stabilized surface channels will carry water away from the fill (30 CFR 715.15 (b)(9)).

All surface drainage from the undisturbed area above the fill must be diverted away from the fill by approved structures leading into water courses (30 CFR 715.15 (b)(10)).

The outslope of the fill shall not exceed 50%. A flatter slope may be required by the regulatory authority (30 CFR 715.15 (b)(11)).

5. Mountain Top Removal

An outcrop barrier of sufficient width, consisting of the toe of the lowest coal seam and its associated overburden, must be retained to prevent slides and erosion (30 CFR 716.3 (b)(1)).

The final surface must be graded to drain inward from the outslope except at specific locations where water drains over the outslope except at specific locations where water drains over the outslope in protected stable channels. Damage to natural water courses below the area mined must be prevented (30 CFR 716.3 (b)(3 and 4)).

The terms of a permit for mountain top removal may be modified by the regulatory authority if it determines that more stringent measures are necessary to prevent or control sllides and erosion, prevent damage to natural water courses, avoid water pollution, or to assure successful revegetation (30 CFR 716.2 (c)(2)).

6. Sedimentation Ponds

All surface drainage from disturbed areas (including reclaimed areas) must be passed through a sedimentation pond or a series of ponds before leaving the permit area unless the disturbed drainage area within the total disturbed area is small and the permittee shows that sedimentation ponds are not necessary to meet effluent limitations. Not included under this provision are areas with no other disturbances upstream. Effluent limitations are listed under the previous section on surface water (see Item 9). Sedimentation ponds must be retained until all water quality and revegetation requirements are met (30 CFR 715.17 (a) and 717.17 (a)).

Sediment removed from ponds shall be done so as to minimize adverse effects on surface waters downstream, on infiltration, on vegetation, and on surface and groundwater quality (30 CFR 715.17 (e)(6) and 717.17 (e)(6)).

All sedimentation ponds must be removed and the affected land reclaimed unless the regulatory authority approves permanent retention (30 CFR 715.17 (e)(10), 717.17 (e)(10); 43 CFR 3041.2-2 (f)(7)(iii)).

7. Diversion Structures

To minimize erosion and prevent water from contacting toxic-producing materials, overland flow may be diverted, if required or approved by the regulatory authority, away from disturbed areas by means of temporary or permanent diversion structures, provided that such structures be designed, constructed, and maintained in an approved manner to prevent additional contributions of suspended solids to stream flows outside the permit area to the extent possible, using the best technology currently available. In no event shall such contributions be in excess of requirements set by applicable state or federal laws (30 CRF 715.17 (c) and 717.17 (c)).

8. Discharge Structures

Discharges from sedimentation ponds and diversion structures must be controlled, where necessary, using energy dissipators, surge ponds, and other devices to reduce erosion and prevent deepening or enlargement of stream channels and to minimize disturbances to the hydrologic balance (30 CFR 715.17 (F) and 717.17 (f)).

9. Roads

Access and haul roads and associated bridges, culverts, ditches, and road rights of way must be constructed, maintained, and reclaimed to prevent additional contributions of suspended solids to streamflow, or to runoff outside the permit area to the extent possible using the best technology currently available. In no event shall the contributions be in excess of requirements set by applicable state or federal law. All such roads and associated structures must be removed and the affected area reclaimed unless retention of a road is approved as part of the postmining land use or is necessary to adequately control erosion and the necessary maintenance is assured (30 CRF 715.17 (1), 717.17 (j), 211.40 (a)(11), 211.41 (c); 43 CFR 3041.2-2 (f)(11)).

All roads insofar as possible must be located on ridges or on the available flatter and more stable slopes to minimize erosion. Stream fords are prohibited unless specifically approved by the regulatory authority as temporary routes across dry streams. Other stream crossings must be made using bridges, culverts, or other appropriately designed structures. Roads must not be located in active stream channels nor can they be constructed or maintained in a manner that increases erosion or causes significant sedimentation or flooding (30 CFR 715.17 (1)(2)(i), 717.17 (j)(2)(i), 211.40 (a)(12)(ii); 43 CFR 3041.2-2 (f)(12)(ii)).

To minimize erosion and subsequent disturbances to the hydrologic balance, roads must be constructed in compliance with established grade restrictions or other grades determined by the regulatory authority to be necessary to control erosion (30 CFR 715.17 (1)(2)(ii) and 717.17 (u)(2)(ii)).

All access and haul roads must have adequate drainage using structures such as, but not limited to, ditches, water barriers, cross drains, and ditch relief drains. Water control structures on access and haul roads to be maintained for more than one year must be designed to pass the peak runoff from a 10-year 24-hour precipitation event (30 CFR 715.17 (1)(2)(iii) and 717.17 (j)(2)(88)).

Access and haul roads must be surfaced with durable nontoxic or nonacid-forming material. Vegetation may be cleared only for the essential width necessary (30 CFR 715.17 (1)(2)(iv) and 717.17 (j)(2)(iv); 43 CFR 3041.2-2 (f) (12)).

Access and haul roads must be routinely maintained, and all structures serving to drain these roads must be kept clean so as not to impede drainage or adversely affect performance of the structures (30 CFR 715.17 (1)(3) and 717.17 (j)(3)).

10. Other Transport Facilities

Railroad loops, spurs, conveyors, or other transport facilities must be constructed, maintained and reclaimed to prevent additional contributions of suspended solids to streamflows or to runoff outside the permit area to the extent possible, using the best technology currently available and to control other diminution or degradation of water quality and quantity. In no event shall the contributions be in excess of requirements set by applicable state or federal law. (30 CFR 715.17 (m) and 717.17 (k)).

11. Final Grading

All grading must be done so as to control erosion and siltation of the affected lands to protect areas outside the affected land from slides and other damage. If not eliminated, all highwalls must be stabilized (30 CFR 715.14 (g)(2) and 715.14 (h)(3))

All final grading, preparation of overburden before replacement of topsoil, and placement of topsoil must be done along the contour to minimize subsequent erosion and instability unless such final grading is hazardous to equipment operators. In all cases, grading, preparation, or placement must be conducted so as to minimize erosion and provide a surface for replacement of topsoil, which will minimize slippage (30 CFR 715.14 (k)).

Small depressions (less than 1 cubic yard) in the final surface may be approved by the regulatory authority to minimize erosion (30 CFR 715.14 (d)).

When rills or gullies deeper than 9 inches form in areas that have been regraded and the topsoil replaced but vegetation has not yet been established, the permittee must fill, grade, or otherwise stabilize the rills and gullies and reseed or replant the areas (30 CRF 715.14 (i)).

12. Revegetation

The permittee must establish on all land that has been disturbed a permanent vegetative cover capable of stabilizing the soil surface with respect to erosion (30 CRF 715.20 (a)(2), 717.20 (b), 211.40 (a)(13), and 43 CFR 3041.2-2 (f)(13)).

Any disturbed areas which have been graded, except water areas and road surfaces approved as part of the postmining land use, must be seeded with a temporary cover of small grains, grasses, or legumes to control erosion until an adequate permanent cover is established (30 CFR 715.20 (c)).

Mulch must be used on all regraded and topsoiled areas to control erosion. Annual grains such as oats, rye, and wheat may be used instead of mulch when it can be shown to the regulatory authority that the substituted grains will provide adequate stability until a permanent vegetative cover is etablished (30 CFR 715.20 (d)).

Areas to be developed for industrial or residential use less than 2 years after regrading has been completed must have a ground cover of living plants that is not less than that required to control erosion (30 CRF 715.20 (F)(2)(ii)).

E. Air Quality

Total suspended particles (TSP) represent the major source of air quality degradation. Emissions of particulate matter are regulated by federal and state law. (Clean Air Act, as amended, 42 U.S.C. Section 1857 et seq.)

The U.S. Department of the Interior coal mining operating regulations (43 CFR, Subpart 3041.1-2 (b)(2)(v)) require applicants to detail strategies for controlling air pollution emissions.

USGS rules and regulations for coal mining (30 CFR 211) require that applications for federal lease lands specify in detail controls to be used in blasting, prevention of fires, and wind erosion. In addition, air quality monitoring is required to ensure maintenance of ambient standards.

F. Soils

The Office of Surface Mining (SM) regulations (30 CFR 700), Surface Mining Reclamation and Enforcement Provisions, deal with soil impacts associated with mining activities. Title 43 CFR 3041 and 30 CFR 211 relative to soil impacts are effectively contained in the more comprehensive OSM regulations, so for purposes of the following discussion those regulations will not be repeated.

1. Topsoil Removal

a. *Removal before mining*. Title 30 CFR 715.16 (r)(1) and 717.20 (a) require all topsoil (unless use of alternate materials is approved under 715.15 (a)(4)) to be removed as a separate operation before any drilling, blasting, mining, road and support facility construction, or other surface disturbing activities. Section 715.16 (a)(1) also limits the size of disturbance at any one time on overburden highly susceptible to erosion.

b. *Horizon segregation*. Section 715.16 (a)(1) and (2) require horizon segregation (soil horizons identified by soil surveys) and maximum use of horizons to achieve 100% soil productivity consistent with postmining land use (715.13).

2. Topsoil Redistribution

a. *Soil productivity*. Section 715.16 (b) requires immediate replacement of topsoil, scarification of regraded surface prior to topsoiling, eliminating slippage surfaces and promoting root penetration, topsoiling in a uniform thickness, prevention of excessive compaction on spoil or topsoil, and protection of topsoil from wind and water erosion before seeding and planting.

b. *Addition of nutrients and soil amendments*. Section 715.16 (d) provides for addition of nutrients and soil amendments as prescribed by soil tests to be applied to redistributed topsoil.

3. Stabilization of Stockpiled Soils.

Section 715.16 (c) deals with topsoil stockpiling. Topsoil must be placed in a stable area not to be disturbed until redistribution, protected from wind and water erosion, and planted with a protective vegetative cover as defined in 715.20 (g).

4. Determination and Treatment of Prime Farmland

To comply with Part 716.7, Prime Farmland, each applicant for a mining permit must determine the status of farmlands to be mined, according to 716.7 (b) and (c), Definition and Identification of Prime Farmlands and 716.7 (d), Negative Determination of Prime Farmland. If a positive determination is made, then a restoration plan must be submitted in compliance with 716.7 (e), (f), and (g).

G. Vegetation

1. Terrestrial Flora

Revegetation on all areas of future coal development will follow the federal surface coal reclamation and enforcement provisions and the rules and regulations for the state concerned.

The Office of Surface Mining regulations found in 30 CFR 700 differ from previous federal regulations in that they are more specific in dealing with impacts on vegetation due to surface mining.

a. Species used in revegation. Section 715.20 (a) requires revegetation of the disturbed areas with species native to the area, and requires that revegetation be carried out in a manner that encourages prompt vegetative cover.

Section 715.20 (b) states that introduced species may be used. If introduced species are used, appropriate field trails must have demonstrated that the species are equal or superior for the approved postmining land use.

Section 715.20 (e) states that the permittee shall use publications or laboratory results for varieties, species, seeding rates, and soil amendment practices. This is to help replace soil stability and prevent erosion.

Section 715.20 (e)(2) and (3) state that hayland, pasture, range, and forest shall be revegetated to obtain a diverse, effective, and permanent vegetative cover with the seasonal variety, succession distribution, and regenerative capabilities native to the area, and livestock grazing will not be allowed on reclaimed land until seedlings are established and can sustain managed grazing.

b. Time of revegetation. Section 715.20 (c) not only covers the mine site itself, but also haul roads and all areas that will require regrading to reduce soil erosion. Seeding and planting of disturbed areas shall be conducted during the first normal period of favorable planting conditions after final preparations.

c. Measures to enhance regrowth. Section 715.20 (d) states that mulch shall be used on all regraded and topsoiled areas to control erosion, to promote germination of seeds, and to increase the moisture retention of the soil.

d. Measuring success of revetation. Section 715.20 (f)(1) states that standards for measuring success of revegetation will be in reference areas that are representative of geology, soils, slope, aspect, and vegetation in the area.

Section 715.20 (f)(2) states that the ground cover on the revegetated areas shall be equal to that of the reference areas. not less than 90% of the ground cover in the reference areas. In previously mined areas, the ground cover shall not be less than the amount sufficient to control erosion, and in no case less than that existing before redisturbance (715.20 (f)(2)(i)). For areas to be returned for agricultural cropland purposes, success of revegetation shall be determined on the basis of crop production from the mined area compared to the reference area as stated in 715.20 (f)(2)(iii).

Section 715.20 (f)(3) states that evaluation of species diversity, distribution, seasonal variety and vigor shall be made with regulatory authority.

e. Revegetation during stockpiling. Section 715.20 (g) states that the topsoil removed shall be stored and seeded with annual or perennial nonnoxious plants.

Section 717.20 (a)(b) states that the permittee shall establish on all mined lands a diverse, effective, and permanent vegetative cover capable of self-regeneration and plant succession before and after mining operations.

H. Animals

1. Wildlife

a. Postmining restoration of wildlife habitat. Section 715.13 (c)(10) of the OSM Provisions (30 CFR 700) requires that wildlife habitat that has been disturbed by mining activity be reclaimed unless certain criteria concerning an alternative postmining use of the area are met.

b. Protection of riparian habitat. Section 715.17 (1)(iii) and 715.17 9d)(3) require the protection of riparian habitat along stream channel diversions and intermittent and perennial streams.

c. Maintenance habitat during mining. Section 715.20 (e)(4) requires that during revegetation the needs of wildlife must be taken into account. It also requires that appropriate plant species be selected and grouped and that water resources be spaced to fulfill the habitat requirements of wildlife.

Part 211.40 (a)(14)(ii) of 30 CFR provides for the fencing of active mining operations and lands undergoing reclamation to regulate wildlife grazing.

2. Endangered Species Act of 1973

To comply with the Endangered Species Act of 1973, any action that alters existing habitat would require in-depth research to ensure that no endangered species would be affected in any way. Endangered species would have to be identified and their use of the area determined.

I. Cultural Components

1. Archeological Resources

Legislation in this area is intended to preserve and, where possible, to enhance archeological resources. To comply with the legislation, five processes must be taken into consideration and completed as necessary: (1) inventory of archeological resources within BLM control; (2) evaluation of all resources against the four criteria of significance prescribed for nomination to the National Register of Historic Places (NRHP); (3) the nomination of resources to NRHP; (4) determination of effect resulting from a proposed federal action to resources on or eligible to NRHP; and (5) preservation of resources not eligible to NRHP. The terms or phrases used for the processes are identical to the products they yield. The applicable legislation is discussed in relation to these five processes.

The Antiquities Act of 1906 (34 Stat. 225, 16 U.S.C. 431 et seq.) established the preservation process for archeological resources on public land. The Secretary of the Interior is charged with carrying out the provisions of the Act for lands under BLM jurisdiction.

The National Historic Preservation Act of 1966 (80 Stat. 915, 16 U.S.C 470 et seq.) authorizes the Secretary of the Interior to expand the National Register to include resources having state and local significance and to establish the Advisory Council on Historic Preservation, which among other duties, reviews and comments on documentation of the harmful effects resulting from any proposed federal action on resources on NRHP or eligible for inclusion on NRHP. Agencies are directed under section 106 of the Act to produce documentation of the degree of effect according to specific procedure and in consultation with the State Historic Preservation Officer. If NRHP quality resources will be harmfully affected, alterntives of avoidance of these resources or mitigation of the effects must be offered. The Act requires the processes of inventory, evaluation of significance, or resources on or eligible to NRHP and preservation by avoidance or mitigation.

The National Environmental Policy Act of 1969 (83 Stat. 852, 42 U.S.C., 4321, et seq.) recognizes the need to preserve archeological resources. The interdisciplinary description of the environmental impacts from major federal action includes these resources.

Executive Order 11593 directs federal agencies to inventory resources under their jurisdiction and to nominate resources eligible to NRHP during a 27-month period. During this interim, the agencies are to exercise caution in activities they either initiate or license to allow for the processes of inventory and evaluation of eligibility and where necessary to allow the Advisory Council to comment on the efforts harmful to the resources from such activities. This order stresses the processes of inventory, evaluation of significance, nomination, and determination of effect on resources eligible to or on NRHP. It assumes that the processes of inventory, evaluation of significance, and nomination would be completed by mid-1973.

Many agencies, including BLM, have not been able to meet the directives in E.O. 11593 and must continue to exercise caution in initiating and licensing activities.

BLM is directed by E.O. 11593 to work with the State Historic Preservation Officer (SHPO) in developing a program to identify resources and evaluate their significance both on public and private lands, to assure that resources of national, state and local significance are preserved.

The fifth process, preservation of resources not eligible to NRHP, is required for resources on federal and state land according to their respective antiquities acts. Although resources may not meet the criteria of significance, they may contain data useful in defining the spatial distributions of specific prehistoric groups or of identifiable cultural horizons. Preservation is required by a lessee under 43 CFR, Subpart 3041., Sec. 3041.2-2 (d).

The most recent legislation granting protection to cultural resources is contained in the Archeological Conservation Act of 1974 (P.L. 93-291; 88 Stat. 174), which specifically directs the Department to conduct, or cause to be conducted, surveys to prevent the loss of significant historical or archeological data that might be caused as a result of any federally licensed project.

2. Aesthetics

a. Planning, location, and construction of facilities. Title 43 CFR 3041.2-2 (d) requires that applicants take visual resources into account in the planning, location, and construction of coal mining facilities.

Cut and fill slopes resulting from all rights-of-way, exploration, building, and other mine-related facility locations must be shaped to a rounding grade that would intersect adjacent terrain at a very low angle; this is to avoid creation of harsh angular forms. All mine spoils and topsoil stockpile areas must be reshaped to a landform that would borrow from the adjacent topography. Title 43 CRF 3041.2-2 (f)(2) and 30 CRF 211.40 (a)(2) further require elimination of highwalls and spoil piles and restoration of the approximate original contour. This would require reshaping of spoil piles and replacement of overburden to conform with or borrow from the adjacent contour; the addition of overburden to original terrain would avoid an unnatural appearing line- or form-dominant feature.

In addition, implementation of 43 CFR 3041.2-2 (f)(12)(ii) would reduce visual impacts accruing to road construction; it requires all roads to be located on flatter slopes to minimize disturbance; this is also required by 30 CFR 211.40 (a)(12)(ii).

b. Protection of visual or scenic resources in general. The Federal Land Policy and Management Act of 1976 makes specific references to the protection of visual or scenic resources, as follows:

- Sec. 103(a) -- When public land is affected by development, important scenic values will be protected from irreparable damage.
- Sec. 103(c) -- Scenic values will be given equal consideration when weighting the use of non-renewable and renewable natural resources.
- Sec. 202 (c)(3) -- In the development and revision of land use plans, the Secretary of the Interior shall give priority to the designation and protection of areas of critical environmental concern (for specific values).
- Sec. 302(b) -- In managing the public lands, the Secretary of the Interior shall, be regulation or otherwise, take any action necessary to prevent unnecessary or undue degradation of the lands, including the scenic values.
- Sec. 504(a)(4) -- Right-of-way boundaries shall be limited to the ground where it has been determined (by BLM) that no unnecessary damage will occur to the environment.

3. Transportation Networks

a. Highway improvement and maintenance. Under Section 35 of the Mineral Leasing Act, states are eligible for grant money. Part of the Section 35 money could be used for public roads in the impacted areas, possibly for use to construct grade separations at railroad crossings and improve and maintain impacted roads in the area. Distribution of Section 35 money is determined by the state legislature.

b. Construction and abandonment of railroad. The Interstate Commerce Act (49 Stat. 543, 49 USC 1(18)) requires prior approval by the Interstate Commerce Commission for extension or new construction of a line of railroad or for abandonment of a line of railroad. Spur, industrial team, switching, or side tracks located wholly within one state are exempted from this authority.

c. Right-of-ways on public land. The Federal Land Policy and Management Act of 1976 provides laws to be followed for right-of-ways across public lands. Right-of-ways included are roads, railroads, transmission lines, and pipelines. These laws will govern the location and construction of right-of-ways on public land.

4. Social Environment

Under provisions of Section 35 of the Mineral Leasing Act, the Secretary of the Treasury is required to return 37.5% of all rentals, royalties, and bonuses received from leases issued under the Act to the states in which leases are located; however, these returns may only be used for roads and schools.

The same section of the Act commits the Secretary of the Treasury to return an additional 12.5% of rents, royalties, and bonuses to the states, where these returns may be used for planning, construction, and maintenance of public facilities, and provision of public services. The state legislature, in its apportionment of the 12.5% return, is directed by the Act to give priority "to those subdivisions of the State socially or economically impacted by development of minerals leased under this Act."

III. STATE AND LOCAL LAWS

State laws are important in many subject areas of coal development and are generally complementary with those of the federal government. This is true, for example, in the areas of air quality and water quality. State standards are allowed to be stricter than those provided for in federal law, but may be no less strict than the federal standards.

It is important to understand the constitutional structure within which the federal government and the states are allowed to legislate for the conduct of activities on the public domain. When the territories of the west became states, the public domain lands within them continued to be owned by the federal government. Because the enabling acts under which these territories became states did not retain federal jurisdiction over these lands, a certain degree of governmental control effectively was ceded to the states. However, the Property Clause of the Constitution does provide for a measure of federal power over these lands:

> The Congress shall have Power to dispose of and make all needful Rules and Regulations respecting the Territory or other Property belonging to the United States; and nothing in this constitution shall be so construed as to Prejudice any Claims of the United States, or of any particular State.[*]

This clause gives Congress authority to pass laws for the protection, management, and disposition of federal lands and resources within the states.[+] Combined with the Supremacy Clause of the Constitution which provides that federal law "shall be the supreme law of the land,"[**] the property clause gives the federal government authority to legislate its proprietary interests. The states have power to legislate as to these public lands and resources so long as the state legislation is not inconsistent with the scheme of the Congress for the property. The state power to legislate generally is found in the Tenth Amendment of the Constitution, which grants to the states all powers not delegated to the federal government or to its citizens. These are the traditional police powers encompassing the health, peace, morals, education, and good order of the people. This category includes the power to implement and enforce land use controls such as zoning and environmental protection measures. Whether state legislation is permitted by the courts to stand turns on the question of whether Congress has acted on the matter so as to effectively preempt any state action or, alternatively, whether Congress has expressly or implicitly left room for the states to legislate.

There is room for accommodation of federal and state interests. As in the previously mentioned air and water quality areas, and more recently in the Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87, 91 Stat. 445, 30 U.S.C. Sec. 1201 (1977)), states are encouraged to develop and implement their own programs, so long as those programs meet federal standards.

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[*] U.S. Constitution, Article IV, Section 3, Clause 2.

[+] Shapiro, Michael E., "Energy Development on the Public Domain: Federal/State Cooperation and conflict Regarding Environmental Land use Control," Natural Resources Lawyer, vol. 9, no. 3, 1976, p. 413.

[**] U.S. Constitution, Article IV, Section 3, Clause 2.

Structurally, substate units of government such as counties and cities act through powers delegated to them by the state government. They cannot have more power than the state government, and they cannot exercise powers greater than those delegated to them by the state. An interesting example of the developing role of county government in the western energy situation is found in Rio Blanco County in northwestern Colorado. The county has passed an "Impact Regulation," or ordinance,

> for the purpose of regulating the use of land on the basis of the impact thereof on the county . . . in order to protect and promote the health, safety, morals, convenience, order, prosperity and general welfare of the present and future inhabitants of Rio Blanco County.*

The Ordinance requires that an "impact analysis statement" be filed for proposed projects that would have significant impact on the "services, activities, or matters" of the county or its incorporated municipalities. The ordinance is comprehensive, as indicated by its definition of "services, activities, (and) matters":

- Schools
- Law enforcement
- Fire protection
- Road . . . construction and maintenance
- Public recreation areas and facilities
- Social Services
- Sewerage and sanitation
- Water supply
- Hospitals
- Storm drainge
- Welfare
- Air quality
- Water quality

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*Rio Blanco County Ordinance, Section 1003.

- Soils and geology
- Vegetation
- Noise
- Wildlife
- Housing
- Utility Service
- Parking
- Traffic
- Historical, prehistorical, and archeological resources
- Flooding
- Odor
- Light and glare
- Area property values
- Other matters as provided for in Colorado law.

If the County Planning Commission finds that the project will significantly and adversely affect these services, activities, and matters, ". . . the county shall not proceed with the required approvals"[*] (i.e., the granting of variances, conditional use permits, building permits, sewage disposal system permits, subdivision approvals, etc.). Rio Blanco County has exercised its police powers with regard to oil shale development in the county.[†] The oil shale lessees, although initially reluctant, honored county ordinances and entered into negotiations with county officials.

The Department of the Interior is sensitive to the issue of state and local government involvement in the coal leasing process. Its Energy Mineral Activity Recommendation System (currently being revised) contains the following language:

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[*] Rio Blanco County Ordinance, Section 1008.3 (2).

[†] White, M. D. and H. J. Barry III, "Energy Development in the West: Conflict and Coordination of Governmental Decision-Making," North Dakota Law Review, Vol. 52, pp. 451-507 (Spring 1976).

> With a growing concern for statewide, county and municipal impacts resulting from a Federal coal program, and with a need to integrate all available geologic and environmental data into the BLM planning system, close coordination with appropriate Federal, State, county and municipal agencies will be maintained. . . . Local government working relationships with the Bureau concerning proposed coal leasing will be initiated at the District Office level. . . . The establishment of working relationships and formal agreements between Federal, state, and local Governmental units regarding resource data collection, assimilation, and analysis and environmental safeguards is an important part of . . . (the Energy Mineral Activity Recommendation System).*

The Federal Land Policy and Management Act of 1976 (P.L. 94-579, 90 Stat. 2743, 43 U.S.C. Sec. 1701-1771 (1976)) provides that 50% of the money from sales, bonuses and royalties and rentals (leases) of the public lands will be paid to the state within which the leased lands or deposits are located (Section 317 (a)). The money is to be used by the state and its subdivisions, as the state legislature may direct. giving priority to those subdivisions socially or economically impacted by mineral development -- for planning, construction, and maintenance of public facilities and provision of public services. The same law authorizes the Secretary of the Interior to make low-interest loans to states and their political subdivisions in order to relieve social or economic impacts occasioned by mineral development (Section 317 (c)(1)). However, there may be problems at the state level in entering into such loan arrangements when a state constitutional provision limits the amount or purpose of indebtedness. There is also the potential for disharmony between state governments and their political subdivisions when it comes to disbursing royalty monies or loan monies by the state.

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*Press release of then-Secretary Kleppe, January 26, 1976.

APPENDIX C

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